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Indian Fisheries and Japanese Enterprise.

THE *Statesman* of Calcutta in its issue of the 17th February 1936, published the following news from its Singapore correspondent under the heading "Fish in Abundance: Japanese Boats operating in Indian Ocean":—

"Japanese trawlers are catching large quantities of fish in the Indian Ocean between Penang and Calcutta and are transhipping it at Singapore for transport to Japan. Previously the trawlers had been operating in the China Sea and off Australia, but their catches decreased owing to the operations of other trawlers in the same waters.

"In the Indian Ocean the Japanese ships, it is stated, are finding an abundance of fish and as much as 80 to 100 tons of fish are transhipped at Singapore for Japan. Most of this is for consumption there but a quantity is shipped back to Singapore as fish meal."

This news does not seem to have caused any stir at the time, but recently when the *Statesman* in its issue of the 5th March 1937 reported the appearance of a Japanese trawler, the '*Shinkyo Maru*,' in the Kidderpore Docks, Calcutta, with a cargo of about 200 tons of fish, "including pomfret, bekti and lobsters caught in the Bay of Bengal," considerable interest was aroused, both in the press and the public, regarding the fisheries of the Bay of Bengal and the paucity of the supply of fish to Calcutta. Though at the time great difficulty was encountered in investigating the significance of this new move on the part of the Japanese vessel, three days later the *Statesman* published a short note on Calcutta's Fish Supply and reported the Japanese plans of working 40 trawlers for the new enterprise. It stated that

"The presence in the port of Calcutta of the Japanese trawler *Shinkyo Maru*, laden with fish from the Bay of Bengal, initiates an experiment made by a long-established business house in Japan.

"One of the fleet of 40 vessels constructed for the purpose, the *Shinkyo Maru* has a capacity for carrying about 500 tons of fish. Its equipment, like that of its sister ships, is most

modern in every respect. Other vessels of the fleet serve Rangoon, Singapore and other Far Eastern Ports.

"It was explained to a *Statesman* representative that this was a well prepared and serious attempt to supply Calcutta with fish, and that interested enquiries from many consumers had already been received.

"Upon the success of the experiment depends the continuation of supplies from this source.

"It has been estimated that in Bengal 80 per cent. of the population consume fish as a regular item of diet when they can afford to buy it; yet so badly is the industry organized and so hopelessly are the actual fishermen in the hands of *mahajans* and middlemen that an ever-increasing demand goes unsatisfied while the price of such supplies as reach the Calcutta markets is maintained at a level which can only be described as exhorbitant.

"The possibilities of establishing remunerative steam trawling in the Bay of Bengal have never been sufficiently explored, even though investigation had proved that there are extensive areas in the Bay capable of yielding large quantities of high-class fish and which are suitable for trawling.

"An experiment that was made was a financial failure mainly because of the hostility of vested interests, and the lack of cold storage facilities. The latter difficulty no longer exists.

"Calcutta consumes about 700–800 maunds of fish daily, but the supply is regarded by dealers as insufficient. In the last decade the demand has increased 40 per cent. but the supply only 25 per cent.

"If the new Japanese enterprise can regularly contribute to the deficiency, and at the same time exert an influence in the way of forcing prices down the visit of the *Shinkyo Maru* may prove economically important."

We have quoted the report of the *Statesman* in full, as it sums up admirably the present position of the fish supply of Calcutta and the necessity for augmenting it from the Bay of Bengal, an immense source of supply near at hand. The public reaction to these statements has been of two opposing types. Some have agreed with the *Statesman* and look upon the Japanese enterprise as a great boon to the poor people whose unbalanced diet is in reality the cause of so much sickness and ill-health in this country and to which the Government has become greatly alive during the last 2 to 3 years. While there are others who consider that the Japanese enterprise will adversely affect a large number of persons engaged in fish trade and that a very big industry, almost next to agriculture in its potentialities, will pass into the hands of the Japanese and it may become politically difficult afterwards to turn them out. Both these views deserve the greatest consideration before any action should be taken in the matter.

There appears to be a general agreement that the Bay of Bengal is teeming with fish life and that all grades of economic fish, from Cat fishes to Pomfrets and Perches, are found in plenty in this area. Two of the Surgeon Naturalists on board the s.s. '*Investigator*,' the late Lt.-Col. A. Alcock and Lt.-Col. R. B. S. Sewell, who had opportunities to do extensive trawling in the Bay have forcefully expressed their views that the fisheries of this area are very rich. The officers of the Government of Bengal, Sir K. G. Gupta, Mr. A. Ahmad, Dr. J. T. Jenkins, Mr. T. Southwell and Dr. B. Prashad, who were appointed from time to time to report on and investigate the possibilities of fisheries, both fresh-water and marine, also came to the conclusion that the Bay of Bengal is almost a limitless source of marine fisheries. A careful study and analysis of the reports of the Government of Bengal's Steam Trawler '*Golden Crown*' also shows that there are many rich fishing grounds in the Bay and, provided a suitable organisation can be set up, there are great possibilities for the development of the Bay fisheries.

The next consideration in such an undertaking would be the disposal of the catches, and here again opinion is unanimous that there is a great demand in Bengal for fish, as almost 80 per cent. of the population would eat fish as a regular item of diet if they could afford to buy it. As the dietetic researches advance there is no doubt that the percentage of the fish-eating population will also increase. As has been stated in the *Statesman's* report quoted above, the demand for fish has already increased during the last decade by 40 per cent. but the supply by only 25 per cent.

It is stated that Bengalis, as a class, are fond of fresh-water fish, mostly carps and a few types of cat fishes, and that there is little demand in the Province for marine fish. In the present circumstances there would seem some justification for this view, because a very small quantity of marine fish is exhibited for sale in Calcutta markets, and even this quantity, which is sold at higher rates than the local fresh-water fish, is brought down for consumption by the foreigners, Europeans and others, in this

cosmopolitan town, from Puri and Balasore by train. Those, who have had opportunities to go round the Calcutta fish markets, are greatly struck by the paucity of the commodity, the average high price of fish of all kinds and the absence for sale of any truly marine forms. The quantity of fish brought to the markets is so small that practically the whole of it is sold out within a couple of hours, and the business is so remunerative that the traders make enough money within this short period. Even if it be admitted that the Bengalis have an inherent prejudice against marine fish, it should be borne in mind that propaganda and education are two very potent agents in overcoming such prejudices. Above all, the necessity of fish diet for a rice-eating population is so great that a simple knowledge of the dietetic value of fish will appease this prejudice. It should also be remembered that whereas the rich may still continue to eat only carps, the poor will readily take to cheaper fish provided it is made available to them. Moreover, the influx of cheaper marine fish will no doubt bring down the prices of other types of fish in the market.

As an instance of what sound commercial propaganda can do, one may cite the instance of "Wolf-fish", a Blennid, of the British coasts. It is so horrid-looking that people detest to buy it, in spite of the fact that its flesh is nice and tasty. Researches have shown that its flesh possesses great nutritive value. To remove the public prejudice against the fish, the traders have given it a sweet commercial name and they never exhibit it for sale with the head intact. Only properly cleaned flesh is sold and very few people, who relish it, know that they are consuming "Wolf-fish".

As an outstanding case of supply and demand one may give another instance of the sale of cartilagenous fishes—Skates and Rays—in Great Britain. Before the War, this type of fish was not much in demand, but during the War when fishing outside the territorial waters became dangerous, the consumption of this type of fish increased. Investigations into the nutritive value of these fishes showed that they were considerably superior to a large number of popular fishes. Thus the fishery of the cartilagenous fishes has come to stay and there is hardly any prejudice against their consumption now.

These instances, which can be multiplied, show what can be achieved by proper organisation and application of science to everyday needs of life. There need not be any diffidence, therefore, regarding the ultimate success of the Bay fisheries. What is needed is the harnessing of financial resources, energy and ability. Above all, the application of science to methods of trade should not be lost sight of.

From the above it is clear that there is a great demand for fish in Bengal generally, and in Calcutta particularly. It is also clear that there is an immense source of supply near at hand. To a layman it would appear a very simple proposition of economics to correlate these two factors. Attempts, unfortunately not fully organised, have been made in the past to fish in the Bay and to supply the ever-growing demand of the Calcutta fish market. But the hostility of the vested interest has been so great that it has been difficult for small enterprises to fight it. It is most essential, that a powerful organisation with considerable financial resources should be set up. The past failures are a great deterrent to the public zeal and, therefore, it would seem to be the duty of the Government of Bengal or of the Corporation of Calcutta to lead the way. A small beginning on the lines of the Bombay Government should be made, small steam trawlers equipped with modern appliances should be purchased, and fast transport of catches from the sea to the cold storage at Calcutta should be organised. When the experiment is carried on for sometime, the public will see the utility of the scheme, and then Government can sell these trawlers and launches to private concerns. Within a very short period under the guidance of a fully trained Indian scientist, such a scheme has achieved a lot and the Fisheries Department of the Province has been greatly expanded. In such enterprises local knowledge is a great asset and, therefore, the failure of some of the earliest schemes of the various Governments can be partly attributed to their importing Europeans for fisheries work.

Now supposing for a moment that the Government of Bengal is not willing to undertake this work and there is no other agency in this country that is likely to work the fisheries of the Bay, is it not desirable to seek the help of foreigners in

this matter? In this connection, it should be remembered that by the International Laws exploitation of the sea products is open to all nationals outside the territorial limits. No one can, therefore, question the rights of the Japanese to fish in the Indian Ocean outside the territorial waters, and if they are prevented from coming to Calcutta they would seek other ports to dispose of their catches. Any interference on the part of the Calcutta citizens with the Japanese enterprise would, under the circumstances, seem like the policy of the dog in the manger. Commenting on "Japan and Bengal Fisheries", the *Statesman* in its editorial of the 15th April 1937 concluded that "Japanese fishermen might be excluded from fishing in territorial waters they can hardly be altogether kept out of the Bay of Bengal. In any event what is good and acceptable for Rangoon and Singapore cannot be altogether bad for Calcutta." This is very sound advice indeed. Those, who have the good of the poor at heart and the interest of the starving millions of Indians, should lose no time in organising the fisheries of the country and place a highly nutritive source of food within the reach of all. If we are not capable of managing it, let outsiders show us the way. An arrangement can be made with an outside agency that after a number of years the terms of agreement will be revised. The sea provides a harvest which requires no sowing. What is needed is its exploitation on proper scientific lines. In our editorial on the Marine Fisheries of India (October 1933) we indicated the lines along which the work should be organised and suggested the creation of a Central Bureau of Fisheries for scientific enquiries and investigations. When early in September 1934, the Advisory Board of the Imperial Council of Agricultural Research held a prolonged discussion on the condition of the Fisheries industry and the possibility of its development, it was expected that the Fisheries Committee to be appointed by them would be able to investigate the question in all its aspects, but unfortunately nothing has so far come out of this talk. It seems to us a most opportune moment to refer to the findings of the Royal Commission on Agriculture on "Fish as an article of diet", because we feel that during the Viceroyalty of Lord Linlithgow, who was the Chairman of the Royal Commission, the fishery problem of India will receive due consideration. It is stated in the report that

"We have been struck with the comparative failure to develop the fisheries of the country as a source of food. We are aware that, in certain parts of the country, there are religious objections to the use of fish as an article of diet. But in Madras and Bengal, it is readily taken and much relished by some four-fifths of the total population. In Burma, it is universally liked and in the form of a fish paste (ngapi) is regarded as an indispensable condiment. In Bombay, the United Provinces and Bihar and Orissa, large classes of the population take it when they can get it and, in the Punjab, there has been, since the War, a largely increased demand for it. Fish forms a specially valuable addition to a diet the staple of which is rice.

"We note with regret that the Fishery Department in Bengal was abolished as a measure of economy in 1923. We understand that the Government of Bengal are desirous of reconstituting it for work on inland fisheries only, as soon as their finances permit. We consider that the development of inland fisheries in Bengal should be regarded as one of the most urgent measures of rural amelioration and we recommend that, if the financial situation does not permit at present of the reconstitution of the department, at least one officer possessed of the necessary qualifications should be placed on special duty to promote interest among local authorities in the stocking of tanks with suitable fish and their conservation. The existing fishery departments in the Punjab, Bihar and Orissa and Madras should be strengthened for the same purpose. A special officer has been recently appointed in Burma with a view to submitting proposals for increasing the efficiency of the inland fisheries. We suggest that his investigations should include an examination of the case for entrusting the development of these fisheries to a properly organised department. We recognise that a certain amount of work is already being done in some provinces in regard to the conservation of the existing stocks of fish. Ladders are being constructed over weirs at the head-works of canals, regulations prohibit the capture of fish by dynamiting, poisoning and the use of small meshed nets, and rewards are being given for the destruction of various enemies to edible fish. Propaganda is also being undertaken to enlist the sympathies of the professional fishermen in the working of such beneficial regulations. There is clearly, however, room for further development in conservancy work along these lines in all provinces.

"Generally, we note that it has been the policy of local governments to insist upon the Fishery Department paying its own way and that, in consequence, the staff has been restricted to a few members. We regard this as a mistake and recommend that a longer view should be taken of the possibilities of development of the fish resources of the country in the interests of the people as a whole. The chief object of the department should not be revenue but public benefit.

"We are fully aware that, if material progress is to be made in augmenting in this way the food supply of rural areas, it will be essential for the district boards, and the rural community generally, to play their part in the stocking of local waters and in their conservancy. It will be for the public health officers and for all organisations interested in the welfare of the people to disseminate a knowledge of the value of the addition of fish to diet. But without some expert authority at provincial headquarters, there will be a risk that ill-advised experiments in stocking may be made and the resultant failures will seriously endanger the prospect of success for the movement as a whole.

"Improvement in the cultivator's diet holds out such promise of improvement in his general health and the addition of fish to his diet impresses us as being so much the most promising way of providing it over large areas of the country, that we consider that we are more than justified in making recommendations which, to those who know the difficulties, may well appear to err somewhat on the side of optimism."

In our opinion the time has come when the Central Government, Governments of the various autonomous provinces, local bodies and the public at large can no longer ignore the development of Indian fisheries, and if there is *no* enthusiasm for such an enterprise in this country we should not stand in the way of the Japanese who would help the masses of India by exploiting the fisheries resources of the Bay.

The Vitamin B_2 Complex and Allied Factors.

I. Mammalian Factors.

By J. R. O'Brien and R. A. Peters.

(*Department of Biochemistry, Oxford.*)

THOUGH many suspected that vitamin B was multiple in nature, convincing proof that this was so was not produced until 1926 when, mainly by the method of feeding supplementary foodstuffs, several workers established that at least two factors were involved in rat nutrition. Of recent times this fact has induced an extensive investigation of the water-soluble factors required not only by the rat but also by the pigeon, chick, etc. It has led to the accumulation of considerable evidence for the existence of several factors generally classified under the heading of vitamin B of which an individual animal may require at least two. Table I is a list of the different factors of the vitamin B group for which evidence has been offered:

TABLE I.

Vitamin B factors (other than vitamin B_1) so far shown to be essential for mammalian nutrition.

Rat ..	vitamin B_2 ..	{ flavin { vitamin B_6—antidermatitic
	vitamin B_4 ..	(position uncertain)
Dog ..	Black tongue factor	
Man ..	Anti-pellagra factor vitamin B_5	(P-P factor of Goldberger)

At present it is important to differentiate the several factors of the rat, pigeon, chick, dog and man because a superficial similarity in chemical and physiological properties suggests but does not prove a relationship among them. Of one factor only, namely flavin, is it possible to speak with some certainty. This has been isolated in crystalline form from natural sources, particularly vitamin B_2 extracts, and its structure established by synthesis. Its physiological properties have been studied in greatest detail in the rat.

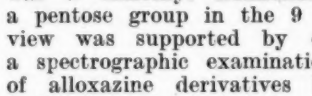
LACTOFLAVIN.[1]

(Ovoflavin from eggs,[2,3] hepatoflavin[4] from liver, and renoflavin[5] from kidney.)

For over 80 years we have been aware of the presence of substances in animal tissues fluorescing in ultraviolet light. Many tissues contain substances fluorescing blue like quinine; Bence-Jones (1866)[6] called this property quinoidine. A preliminary investigation by Kinnersley, Peters and Squires (1925)[7] indicated that the blue fluorescence of tissues was due to more than one quinochrome (*i.e.*, substances fluorescing blue) and that those in yeast accompanied but were not identical with vitamin B_1. In 1933 a new class of natural pigments with a yellow-green fluorescence came into prominence. The biological significance

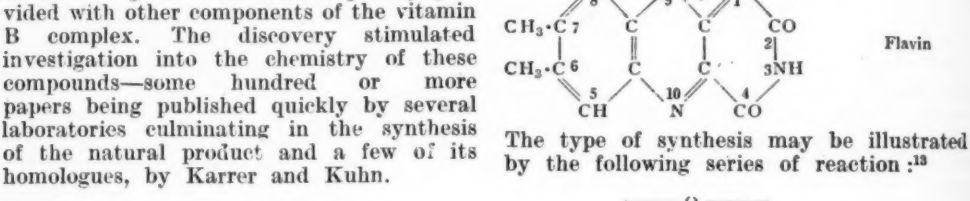
of these compounds, called flavins, was realised from the earlier isolation from yeast of an iron-free enzyme consisting of a yellow-green fluorescent component united with a protein. [Warburg and Christian (1932)[8].] Separation of the fluorescent prosthetic group, easily effected by hydrolysis, yielded an orange crystalline substance of composition $C_{17}H_{20}N_4O_6$. Meanwhile a detailed examination of the yellow-green fluorescing substances in tissues by Ellinger and Koschara[9] and Kuhn and his coworkers[10] showed that Warburg's substance was a member of a class of compounds, the lyochromes. Further emphasis on the importance of these substances was given by the report of Kuhn, György and Wagner-Jauregg[10] who, working on the nature of vitamin B_2, isolated a crystalline substance which proved to be identical in composition with the flavin of Warburg and promoted the growth of rats adequately provided with other components of the vitamin B complex. The discovery stimulated investigation into the chemistry of these compounds—some hundred or more papers being published quickly by several laboratories culminating in the synthesis of the natural product and a few of its homologues, by Karrer and Kuhn.

The steps leading to the elucidation of the structure of flavin were briefly as follows:—Warburg and Christian (1932)[8] had already shown that irradiation of flavin in alkaline solution caused its destruction with the loss of four carbon atoms and the production of lumiflavin. Upon alkaline hydrolysis lumiflavin decomposed yielding a molecule of urea. Detailed examination of the degradation products by Kuhn, Rudy and Wagner-Jauregg[11] showed that the loss of 4 carbon atoms upon irradiation arose from the breakdown of a pentose chain, confirmed the loss of urea from lumiflavin by hydrolysis and found that the acid formed simultaneously had a molecular composition suggesting a quinoxaline structure. It was therefore presumed that flavin was a dimethyl isoalloxazine containing a pentose group in the 9 position. This view was supported by evidence from a spectrographic examination of a series of alloxazine derivatives by Stern and Holiday.[12] The synthesis of flavin rapidly followed. Several homologues of the natural substance were prepared before lactoflavin itself was actually obtained. From a comparison of the biological and chemical properties of the synthetic compounds and of natural flavin the structure assigned to flavin was 6·7-dimethyl-(*d*-1′-ribityl)-isoalloxazine.



Flavin

The type of synthesis may be illustrated by the following series of reaction:[13]

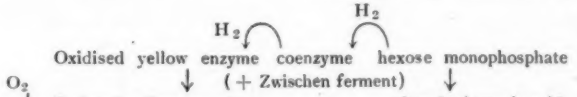


Other methods of synthesis are: Condensation of pentose with the N-mono-acyl or preferably carbethoxy-amino derivatives of dimethyl phenylene diamines.[14] After reduction with nickel and hydrogen in an autoclave, the condensation product is allowed to combine with alloxan when flavin is formed. The synthesis is achieved by Kuhn and Weygand[15] by condensing amino pentose with *o*-chlor nitro xylene. The labile N substituted diamine is reduced in the presence of alloxan by stannous chloride. After removal of the excess of

reducing agent the leucoflavin is oxidised by shaking with air.

The flavins are orange-yellow crystalline solids soluble in water, slightly soluble in alcohol but otherwise insoluble in organic solvents. Their characteristic feature is a yellow-green fluorescence accompanied by marked sensitivity to light.[8,10,16,17-22] According to the experimental conditions two main products arise from the irradiation of flavin solutions: (*a*) in alkaline medium, lumiflavin (6·7-dimethyl-9-methyl-isoalloxazine) and (*b*) in neutral solution, lumichrome (6·7-dimethyl-alloxazine), an intensely blue fluorescent compound.[19] Another interesting property is the reversible oxidation reduction of flavin. On treatment with hydrosulphite flavin is reduced to a colourless leuco form which is reconverted to the original yellow-green form on shaking with air. The smoothness and the ease with which these reactions proceed suggests a relation with the physiological function of flavin.

A further clue to the physiological rôle of flavin is given by the mode of combination in which it exists in various animal plant tissues. In yeast and in such organs as liver, heart, kidney, flavin exists in two forms: free flavin and flavin in a non-dialysable form. Warburg has shown that his yellow enzyme is a protein carrying flavin as a prosthetic group. More recently, Theorell[23] has found that the flavin in the yellow enzyme is actually present in the esterified form of a phosphate. Treatment of the enzyme with acid leads to a decomposition into flavin phosphate and protein. In neutral solution both these fragments recombine to give a product possessing the same activity as the original enzyme. The action of the yellow ferment has been studied by Warburg particularly with hexose monophosphate (Robison ester) as substrate. In the oxidation of hexose monophosphate to phospho-hexonic acid, flavin apparently functions as a vehicle for oxygen transportation:



A deficiency of flavin in the diet manifests itself most definitely in the rat although evidence has been presented that this substance is required by other mammals. In the rat it is now generally agreed that flavin deficiency results in a loss of appetite and cessation of growth accompanied after some weeks by the appearance of scurf-like symptoms in the vicinity of the eyes and mouth which are different from the dermatitis usually associated with lack of vitamin B_2. The hair is shed with the development of bald patches over the head and face but no swelling or inflammation of the paws occurs (Copping, 1936).[24] The daily administration of 15γ of flavin promotes growth and restores the hair. The flavin is given in the free form; apparently the rat is capable of converting it into flavin phosphate. In fact some evidence has been presented showing that this may take place in the intestines (Verzàr, 1936).[25] It may be presumed provisionally that the necessity for flavin in the diet is to maintain the supplies of the yellow enzyme. But it is still possible that it has a function in the free state as there are suggestions in the literature that it can act as a catalyst in relation to certain dehydrogenase systems: the matter requires further investigation. It is to be noted that overdosage of some compounds allied to the flavins may result in the appearance of toxic symptoms, for Kuhn and Boulanger (1936)[26] found that with rats isoalloxazines, particularly the 9 phenyl derivative, were toxic.

Vitamin B_6.

The isolation of crystalline flavin from vitamin B_2 concentrates elucidated to some extent the conflicting results of different workers obtained in the study of the antidermatitis factor and raised the question of its possible multiple character. For, in 1930 Chick and Copping[27] and Roscoe[28] published data suggesting that the nature of vitamin B_2 was probably more complicated than previously supposed. These workers presented evidence for the existence of a factor, termed by them "Factor Y" of a stability to heat and alkali greater than vitamin B_2. The importance of this observation was more fully recognised when Kuhn, György and Wagner-Jauregg[10] found that flavin alone was incapable of

curing rat dermatitis and promoting growth. The missing essential constituent could be provided by the addition to the diet of an acid charcoal adsorbate of yeast, a source of vitamin B_4. The heat stability and curative action towards rat pellagra led György to call the missing factor, vitamin B_6.[29] Chick and her colleagues[30] and György[29] are now agreed that vitamin B_6 and factor Y are identical and together with flavin constitute what was previously known as vitamin B_2. It is important to remember that at present the term vitamin B_6 connotes an impure concentrate which may contain other additional factors.

The effect of a deficiency of vitamin B_6 has been amply demonstrated by feeding rats on synthetic diets supplemented with vitamin B_1 and flavin in their pure crystalline forms. From such experiments it has been found that typical rat dermatitis, previously attributed to lack of vitamin B_2 occurs only when the fraction of the vitamin B_2 complex termed vitamin B_6 is absent from the diet. The deficiency creates skin lesions of florid nature and of symmetrical distribution. Initially they manifest themselves by a soreness at the nose, eyes and ears and a redness and swelling of the feet. With time they accentuate: the pinnæ are thickened and encrusted; there is a marked œdematous appearance of the mouth and the paws; the latter are usually scabby. Simultaneously these symptoms are accompanied by gastro-intestinal disturbances.* The urine may be reduced in volume and be highly pigmented containing porphyrin. Such symptoms are rapidly alleviated by the administration of Peters' eluate, the decomposed lead precipitate from yeast extracts or by liver extracts.[31]

From time to time attempts have been made to correlate the symptoms of vitamin B_2 deficiency with lesions other than dermatitis. It has been proposed to term vitamin B_6 the rat acrodynia factor[32] on the basis of a similarity of the dermatitis observed in rats to the condition of the hands, etc., seen in children suffering from Pink disease. Such a superficial resemblance may be visualised but neglects the other aspects of the clinical picture of Pink disease. In the opinion of one of the authors, the symptoms do not resemble in detail Pink disease in children.† It has also been suggested that vitamin B_2 evokes cataract in rats.[33,34] At present in view of the conflicting evidence which may be in part due to the use of different diets, it is impossible to reach a definite conclusion. In our laboratory no instances of cataract have so far been observed in young rats on a diet deficient only in vitamin B_6.

In Table II is summarised the distribution of flavin and vitamin B_6:

TABLE II.

Distribution of flavin and vitamin B_6.[1,2,5,29,31,50,51]

Source	Flavin	Vitamin B_6
Yeast ..	+ + +	+ + +
Liver ..	+ + +	+ + +
Fish muscle ..	small amount	+ + +
Egg white ..	+ + +	small amount
Kidney ..	+ + +	?
Milk ..	+ + +	+ + +
Muscle ..	+	
Suprarenals ..	+	
Corpus Luteum ..	+	
Brain ..	+	
Retina of eye ..	+	

It will be observed that whereas flavin and vitamin B_6 are somewhat equally distributed in liver and yeast, they are unequally so in the egg white, fish muscle and other tissues. White of egg contains mainly ovoflavin with little vitamin B_6 a fact which accounts for the early observation of Chick on egg white as a source of vitamin B_2.

Of the chemical nature of vitamin B_6 little is known. It is not precipitated by the salts of Pb, Hg or Ag; it is precipitated by phosphotungstic acid, is adsorbed on Fullers' earth at acid pH, inactivated by benzoylation, untouched by nitrous acid, migrates towards the cathode on electrodialysis. It may be a basic substance containing an OH group.[35]

VITAMIN B_4.

This factor is now not so well defined an entity as the original methods of testing

* This is suggested by the occurrence of diarrhœa and abnormal appearance of the gut on post-mortem examination.

† The symptoms resulting from a deficiency of Reader's vitamin B_4 did resemble Pink disease, but see below.

for it have broken down. Originally Reader (1929)[36] described a third rat factor under the name of vitamin B_4 which promoted the growth of young rats on a diet supplemented by autoclaved marmite (vitamin B_2) and a preparation of vitamin B_1 free from vitamin B_4.‡ Later owing to the difficulties of test, the development of a method using adult rats was undertaken. On the same diet the rats showed peculiar symptoms of redness and swelling of the paws together with ataxia. Endeavours to substantiate these findings have failed, the red swollen paws being observed in only 1-2 per cent. of the experimental animals. Ataxic symptoms when present could be cured by the administration of 3-5 units of vitamin B_1 in the form of a crude concentrate or pure crystalline form.[37] The conflicting results may be explained in the future when we possess a pure preparation of vitamin B_6. The difficulty of producing vitamin B_4 deficiency in the rat has been indicated by Kline, Elvehjem and Hart[38] who consider that careful purification of the dietary constituents and the use of highly potent concentrates of the other factors of the vitamin B complex are essential for success. These workers succeeded in reproducing the ataxic symptoms without the red swollen paws, and found that pea nuts alleviated the condition.§

Pellagra.—Pellagra is a disease characterised by gastro-intestinal disorders, nervous disturbances and extensive skin eruptions, occurring in different parts of the world, particularly maize-eating countries. The nature of the causal agent is still a matter of dispute although of recent times, it has generally been held to be of dietary origin. The work of Goldberger and his colleagues[40] in America and Wilson[41] in Egypt laid the foundations for this hypothesis. The early view of Wilson (which he himself still maintains) that a shortage of protein of high biological value was responsible for the condition gave place to one of vitamin deficiency. In exploring the curative properties of different foodstuffs Goldberger reached results difficult to reconcile with the assumption that adequate protein in the diet cured pellagra. A protein such as casein showed no curative action whilst an acid extract of yeast containing little protein matter was effective in curing the disease. These results led to the postulation of the P-P factor, a deficiency of which caused the onset of the pellagrous condition. The close resemblance of the symptoms seen in the rat deprived of vitamin B_2 to those in pellagrins suggested a similarity if not identity in nature in the P-P factor and vitamin B_2. Aykroyd and Roscoe[42] pointed out that the distribution in foodstuffs of vitamin B_2 and the P-P factor was similar. Experimental black tongue in dogs, a pellagrous condition, is reproducible on pellagrin diets and is cured by a factor which, like vitamin B_2, is thermostable: yet two features, associated with human pellagra, a prevalence in maize-eating countries and the detrimental effect of sunlight have still to be correlated with these results. So far it has not been completely proved that sunlight stimulates rat dermatitis. (Hogan[43] has produced a form of dermatitis by exposure of rats to ultra-violet light.) Even more difficult to reconcile with the view that vitamin B_2 and the P-P factor are one and the same is the finding of Birch, György and Harris (1935),[44] that maize and the diets of pellagrins are rich in vitamin B_6. Dogs are found to develop black tongue when fed on a Goldberger maize diet containing large amounts of vitamin B_6. It is therefore concluded that vitamin B_6 is a factor distinct from the P-P factor and the anti-black tongue factor although the two latter may be identical. That flavin is not the P-P factor has been demonstrated by Dann who observed no improvement in pellagrins on administration of the compound. Despite such evidence indicating that human pellagra, rat dermatitis and black tongue in dogs arise from deficiency of different entities, it is also possible that one or more factors are operative in a given condition. The cures of children suffering from stomatitis by feeding such sources of vitamin B_2 as yeast and milk have been made by Aykroyd and Krishnan[45] who discuss the possibility of pellagra arising from a deficiency of more than one factor.

Vitamin B_2 and Anæmia.—The co-existence of vitamin B_2 and the extrinsic factor of pernicious anæmia in liver, liver extracts, marmite and yeast led Castle and Strauss

‡ Probably flavin was the factor under test.

§ It has recently been reported by McHenry[39] that vitamin B_4 is possibly choline, but his experiments require confirmation.

(1932)[46] to suggest that vitamin B_2 was probably the extrinsic factor upon which the intrinsic factor acted. This view has not been confirmed. Wills (1933)[47] incubated purified extracts of vitamin B_2 with the intrinsic factor and found no improvement in cases of anæmia treated with the digestion mixture. More recently Wilkinson (1935)[48] showed that flavin was ineffective in anæmia. The isolation of the anti-hæmatopoietic factor by Dakin and West (1935)[49] should throw light upon the possible relation of the anti-anæmia factor to vitamin B_2 complex.

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[51] v. Euler and Adler, *Zeit. f. physiol. Chem.*, 1934, **228**, 1.

Interspecific Hybrids in *Secale* (rye).

I. *Secale cereale* × *Secale ancestrale*, *Secale cereale* × *Secale Vavilovii*, *Secale cereale* × *Secale montanum* and *Secale ancestrale* × *Secale Vavilovii* Hybrids.

By Dontcho Kostoff.

(*Academy of Sciences, Institute of Genetics, Moscow.*)

WE have grown since 1931[1] (Kostoff, 1932) *Secale cereale* × *Secale montanum* hybrids and their progeny, while the other three hybrids we raised first in 1936. The cultivated species *Secale cereale* has non-brittle spikes while all the wild ryes have brittle spikes. F_1 hybrids have brittle spikes. The F_1 hybrids of the cross *cereale* × *montanum* has highly reduced fertility, while the others are highly fertile, especially the hybrid *S. cereale* × *S. ancestrale* showed an almost normal fertility. The hybrid *S. cereale* × *S. montanum* has about 75% viable pollen, while the other hybrids have a much larger percentage of viable pollen. The hybrid *Secale cereale* × *S. ancestrale* had almost normal pollen (93–97%). All hybrids were robust and produced numerous spikes.

Each *Secale* species used in our work had $n = 7$ and $2n = 14$ chromosomes[2] (Kostoff, Dogadkina and Tihonova, 1935). The F_1 hybrids *Secale cereale* × *montanum* had 5–7 bivalents, while all the other hybrids had usually 7 bivalents in the pollen-mother cells during the first meiotic metaphase. The formation of one and very often of more than one chiasmata indicates that crossing-over occurs between the chromosomes of the maternal and paternal species, which gives the possibility of recombination of characters between the cultivated and the wild ryes. The formation of seven bivalents in the hybrids studied, indicates that the genom of *Secale cereale* (S) is homologous with the genoms of *S. ancestrale*, *S. Vavilovii* and *S. montanum*.

The meiotic division in the hybrids: *Secale cereale* × *S. ancestrale*, *S. cereale* × *S. Vavilovii*, and *S. ancestrale* × *S. Vavilovii* proceeds almost normally. Only slight irregularities were found, that lead occasionally to formation of non-viable gametes. Meiotic division in *S. cereale* × *S. montanum*, however, had somewhat more irregularities. The occurrence occassionally of

Fig. 1.

Fig. 2.

Fig. 1.—Meiotic metaphase from a pollen-mother cell of F_1 *Secale cereale* × *Secale ancestrale* hybrid with 7 bivalents.

Fig. 2.—Meiotic metaphase from a pollen-mother cell of F_1 *Secale cereale* × *Secale Vavilovii* hybrid with 7 bivalents.

two univalents or an unsimultaneous separation of the bivalents during the first meiotic divisions were chiefly the causes for the irregularities observed. The occurrence of a relatively large percentage of abortive pollen in this hybrid seems to be partly due to the irregular meiosis and partly to the retardation of certain processes proceeding in the anthers of the hybrid plants (Kostoff, 1932). The relatively high sterility of this hybrid is probably due not only to the relatively larger percentage of abortive pollen (than in the other hybrids) but to certain sterility factors of the type described by East in *Nicotiana*, which are also responsible for incompatibility of the cultivated rye when self-pollinated.

The majority of the plants obtained from selfing *S. cereale* × *S. montanum*, and especially those produced from the back crosses of *S. cereale* × *montanum* to *S. cereale* are more fertile than the F_1 hybrids. In the F_4 and F_5 generation we produced plants and lines which were very productive. Some plants of the F_2 generation were, however, completely sterile. We found even heteroploid forms in F_2 generation with 15 somatic chromosomes. One plant was found,

[1] Kostoff, D., "Pollen abortion in species hybrids," *Cytologia*, 1932, **3**, 337–39.

[2] Kostoff, D., Dogadkina, N., and Tihonova, A., "Chromosome number of certain *Angiosperm* plants (*Nicotiana*, *Petunia*, *Oxalis*, *Secale* and *Punica*)," *Compt. Rend. Acad. Sci.*, URSS, 1935, **3**, (8), No. 9, pp. 401-404.

that had 23 somatic chromosomes. These aberrants are unavoidable sequence from the irregularities in the reduction division of F_1 hybrids. The aberrant plants were completely sterile. The extra chromosome in the trisomics was normal in size, but it was not a fragment as in Gotoh's (1924, 1932) forms.

Trisomic plants have probably originated after fusion of one gamete having 8 chromosomes with a normal gamete having 7 chromosomes. Gametes with 8 chromosomes can be formed when 6 bivalents and 2 univalents are formed during the first meiosis if both univalents go to one of the poles ($6 + 2 = 8$).

The plant with 23 somatic chromosomes has probably originated after fusion of one gamete having 16 chromosomes with a normal gamete having 7 chromosomes. Gametes with 16 chromosomes can originate from an 8 chromosomic nucleus formed after a chromosome distribution of 8–6 instead 7–7 during the first meiosis as just mentioned and then a doubling following non-occurrence of the second division.

Hybrids between cultivated rye and *S. montanum* has been occasionally produced by plant breeders (Duka). *S. montanum* is a perennial species and one can combine this character with the characters of the cultivated rye by hybridization. We wish to call the attention of the plant breeders that *S. ancestrale* might be used with success in plant breeding work when crossed with the cultivated rye. *S. ancestrale* is a productive and robust species and seems to be one of the most closely related species to the cultivated rye. *S. Vavilovii* behaves in the hybrids with cultivated rye in a similar way as *S. ancestrale*, but it is not so robust and so productive as *S. ancestrale*.

We are greatly indebted to Com. Omelnitzkaya, A. Tihonova, N. Dogadkina and Z. Vishemirskaya for help throughout this work.

Liesegang Rings and the Influence of Media on their Formation.

By Dr. B. N. Desai.
(*Meteorological Office, Karachi.*)

THE role of gels in the production of banded precipitates has been the subject matter of many investigations. In the *Lucknow University Studies** Dr. A. C. Chatterji has given a summary of investigations carried out by him in collaboration with Dr. N. R. Dhar and others on "Liesegang rings and the influence of media on their formation". From the results of lead chloride, lead iodide and silver molybdate rings in agar, gelatine, silicic acid and starch gels, it has been inferred that with the same sparingly soluble precipitate, the character of the ring considerably changes when produced in different gels. In some, it is found very difficult to produce rings, while in others the formation of rings is very easy.[1] The gel is considered to have a specific influence and is by no means an indifferent medium which prevents mixing or merely fixes the precipitate at the position of formation.

Chatterji and Dhar attributed the specific nature of the gel to its protective effect in ring formation. According to their theory[2] of the Liesegang phenomenon, the rings are formed by the coagulation of a peptised sol. The coagulated mass in the course of its formation and when precipatated adsorbs and coagulates completely or partially the sol of the same substance from the neighbouring layers. Their theory differs from that of Ostwald[3] according to which the gel produces a supersaturated solution of the substance to be deposited in bands which are actually produced when the supersaturation is released and from that of Bradford[4] according to which one of the reacting substances is adsorbed by the layer of the precipitate, the result being a zone practically free from it, so that the clear spaces between the rings are at once accounted for.

In support of their theory of Leisegang rings Chatterji and Dhar[5,6] have recorded conductivity and E.M.F. measurements which show that Ag_2CrO_4, AgCl, AgCN, AgBr

* Faculty of Science, 1934–35 Session, No. 7, July 1936.

and AgI in gelatine gel are almost wholly in a state other than ionic. The results of Williams and Mackenzie,[7] Bolam and Mackenzie,[8] Desai and Nabar,[9] and Bolam and Donaldson,[10] indicate, however, that silver chromate is present in gelatine mainly in ionic condition. Naik, Desai and Desai[11] have subsequently found that silver chromate in gelatine is mostly in a condition other than ionic. These results of Desai and co-workers have been considered by Chatterji as corroborating his own work and hence supporting Dhar and Chatterji's theory of Liesegang rings.

It has to be pointed out that more recently Khanolkar, Barve and Desai[12] have shown that by suitable adjustment of the (i) temperature of the experiments, (ii) pH of the gelatine, (iii) concentration of the reactants and (iv) amount of gelatine, conditions can be so changed that the conductivity may (*a*) not decrease while the yellow colour persists, (*b*) decrease sometime after the colour change from yellow to red or (*c*) not change at all in spite of the colour change, the supersaturation being largest for case (*a*) and nil for case (*c*). It has been mentioned by Chatterji[13] that the percentage of silver chromate in condition other than ionic can be decreased by increasing the acidity of the medium due to enhanced solubility of the silver salt in acids. On the other hand Khanolkar, Barve and Desai[12] have shown from experimental results that while the percentage of silver chromate in non-ionic condition in the yellow mixtures (*i.e.*, before the appearance of the red colour) decreases with an increase in the acidity of gelatine solution, it is at a maximum in the red mixtures for pH value 5·75 (when conductivity does not change on standing). The conclusions of Chatterji and Dhar about the condition of silver chromate in gelatine are not therefore supported by the latest results of Desai and his co-workers.

It is doubtful if the theory advanced by Dhar and Chatterji about the formation of Liesegang rings in gels can be taken as satisfactory. According to Bradford[14] any substance can give a banded precipitate if it is obtained in a fine condition. The gels when used as media for the formation of rings, cause the substance to be deposited in a very fine condition, the fine particles being not always charged. According to the theory of Chatterji and Dhar one would expect that rings are not formed in cases where the substance to be deposited cannot previously be produced in colloidal condition.[15] Lloyd and Moravek[16] have, however, shown that periodic precipitation can be obtained even in gaseous, fluid and solid media besides gels; they have further shown that the effects of spatial relations, surface, concentrations of the reactants, temperature at which the reaction takes place, forward and backward diffusion, etc., have also to be taken into account besides the effects of media and of adsorption by the precipitate. From a critical examination of the various theories which have been put forward by different investigators it may be concluded that no single theory can explain all the known facts about banded precipitation.

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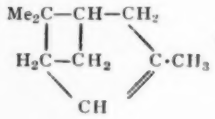
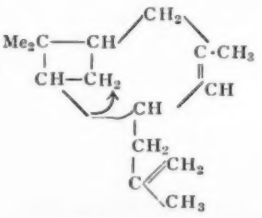
LETTERS TO THE EDITOR.

The Structure and Probable Biogenisis of β-Caryophyllene.

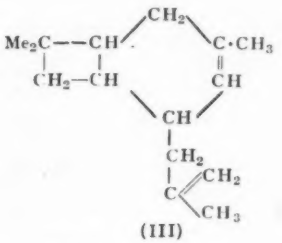
THE structure (III) assigned to β-caryophyllene by Ruzicka[1] has also been shown by Ramage and Simonsen[2] to be the most satisfactory representation. There seems to be some additional indirect evidence pointing to the correctness of the structure of Ruzicka [besides its being visualised as in (IV) to be made up of a unit of ocimene and one of isoprene], in that it has a very close resemblance to the bicyclic terpene, "orthodene" (I) which Fujita[3] has isolated from the oil of *Orthodon lanceolatum* along with caryophyllene. The similarity between the two structures (I) and (III) and the occurrence of the two terpenes in the same oil suggest that biogenetically both these compounds should be closely related. It is likely that β-caryophyllene is formed from orthodene by the addition of an isoprene unit (or its biological equivalent), probably by the isomerisation of the intermediate form (II).



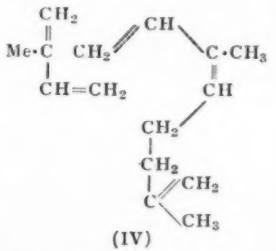
(I)



(II)



(III)



(IV)

It is significant that the formation of β-caryophyllene according to this mechanism is quite in conformity with the positions of the double bond and the isopropenyl group in the formula of β-caryophyllene as advanced by Ruzicka.

K. GANAPATHI.

Department of Organic Chemistry,
Indian Institute of Science,
Bangalore,
May 5, 1937.

[1] *J. Soc. Chem. Ind.*, 1935, **54**, 509.
[2] *J. C. S.*, 1937, 73.
[3] *Am. Chem. Abs.*, 1934, **28**, 1470; *J. Chem. Soc.*, Japan, 1933, **54**, 1811.

Crystalline Globulin from *P. aconitifolius* Jacq.

A CRYSTALLINE globulin has been isolated from the seeds of aconite bean, *P. aconitifolius* Jacq. The seed meal was extracted with hot (60° C.) 5% sodium chloride solution. The clear filtered extract was diluted with hot distilled water until a slight turbidity appeared; it was warmed on the water-bath till it became clear and allowed to cool gradually. The precipitated protein was separated on the centrifuge, redissolved in hot saline and reprecipitated as above, and the treatment was repeated for a third time. The protein was repeatedly washed with distilled water till free from chloride.

Fig. 1.
Betweeen crossed nicols × 45

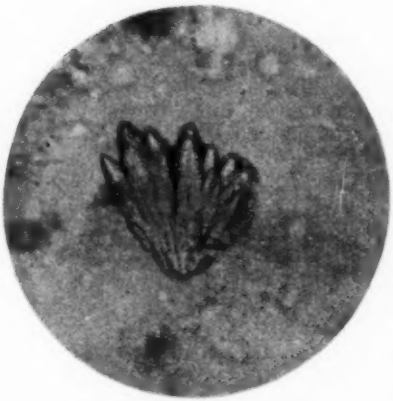


Fig. 2.
× 120

The globulin when examined under a polarising microscope showed a spherulitic structure (Fig. 1), and on standing the spherulites developed into radiating needles (Fig. 2).

The crystalline globulin was dried in the usual manner and tested for its purity. Tyrosine and tryptophane were also estimated by the colorimetric method of Folin and Merenzi.[1] Results are incorporated in Table I.

TABLE I.

Ash.	Total N.	Tyrosine.	Tryptophane.
(% of Globulin)		(% of Total Nitrogen)	
0·3	15·99	2·6	0·5

KAMALA BHAGVAT.

[1] Folin and Merenzi, *J. Biol. Chem.*, 1929, **83**, 103.

Volatilisation of Ammonia from Indian Soils.

DURING the past few decades, a large number of workers, from different parts of the world, have drawn attention to loss of nitrogen from soils and consequent diminution in fertility. Several theories have been advanced to explain the phenomenon but the mechanism of loss has not yet been fully understood.

Hutchinson[1] drew attention to possible loss of nitrogen through volatilisation of ammonia from soils treated with large excess of organic manures. Sreenivasan and Subrahmanyan[2] noted that there was considerable loss of ammonia from swamp soil treated with organic manures, especially those with narrow C–N ratios. They showed that similar losses—though not so pronounced—occur even under conditions of dry cultivation.

Gundu Rao and Subrahmanyan[3] observed that there was volatilisation of ammonia even from soils treated with ammoniacal fertilisers. The possibility of such a loss is now recognised and, indeed, in Egypt and Sudan the fertiliser is buried in the soil immediately after application. It is very doubtful, however, whether even this is effective in preventing loss of nitrogen. The following results relating to some representative Indian soils will illustrate the position :—

The soils (29 g. each) were treated with 10 c.c. each of an aqueous solution of ammonium sulphate containing 3×10^{-4} g. of nitrogen per c.c. This would correspond to 150 mg. of nitrogen per kg. of soil. The experiments were carried out in small dishes provided with lids. Ammonia lost by volatilisation was estimated by absorption in filter paper (Whatman, No. 30 or 41) previously moistened with known quantities of standard acid. (The technique of estimation is described in detail elsewhere.) Temperature, 23–27°C.

TABLE.

Soil	Ammonia lost (as mg. of N per kg. of Soil) at the end of Time in days				
	1	3	5	7	10
1	27·8	36·7	43·1	49·1	53·2
2	48·1	91·2	105·2	119·1	128·0
3	38·0	79·8	98·8	111·5	121·6
4	Nil	5·1	10·1	12·7	14·0
5	27·8	43·1	52·0	57·0	60·8
6	18·5	25·3	30·4	35·4	37·6
7	17·8	29·1	39·3	45·6	48·1
8	49·4	92·5	111·5	125·4	139·4
9	26·6	48·1	59·6	67·2	72·6
10	36·7	68·5	86·1	97·6	107·7

1. Rice land from Gurdaspur Dt., Punjab; 2. Clay soil, Fruit Farm, Mirphurkas, Sindh; 3. Calcareous soil, North Bihar; 4. Paddy soil, Dacca; 5. Paddy soil, Mandalay; 6. Laterite soil, Chota Nagpur; 7. Upland soil, Cuttack, Orissa; 9. Paddy soil (alkaline), Travancore.

The other results may be summarised as follows:—(1) In presence of adequate amounts of moisture and on prolonged exposure, almost all soils treated with ammoniacal fertislisers lose ammonia, the extent of such loss depending on the nature of the soil and the previous treatment received by it. Certain types of soils—especially alkaline or calcareous—lose nitrogen very rapidly. In some cases, ammonia is given off almost immediately after addition of the fertiliser. Under similar conditions, black soils generally suffer heavier losses than red ones. The loss is much less from laterite and acid types of soils and in some cases there is practically no loss after the first few days. (2) The extent of loss increases (up to a point) with the concentration of the ammonium salt. Increase in the proportion of soil reduces the loss in some cases (especially when the soils are acid), but enhances it in others. (3) Volatilisation of ammonia is due to purely chemical agencies. Similar results are obtained from fresh as well as sterile soils. (4) Basal dressings of lime (slaked or unslaked) facilitate liberation of ammonia and consequent volatilisation from all types of soils. (5) Increased moisture content helps to retain ammonia to some extent, but is not entirely effective in preventing the loss. (6) Volatilisation is comparatively slow at lower temperatures (23–27° C.), but proceeds very rapidly at 37° C. and above, which are usually attained in the tropics. (7) The rate of loss varies with different ammonium salts. Thus, the phosphate (diammonium salt) loses ammonia more rapidly than the sulphate or the chloride. (8) Addition of cellulosic materials is fairly effective in checking volatilisation, especially after the material has undergone some preliminary decomposition.

The above observations would appear to be of considerable practical significance, especially to tropical agriculture. They account, at least partly, for the low level of nitrogen ordinarily found in such soils. They also show why ammonium salts are not so effective or liming so beneficial, in tropics as observed in temperate regions. They would also provide an additional reason for the physiological acidity of ammonium salts which has so far been considered to be exclusively due to preferential intake of ammonium ion by plants.

Further researches are needed to determine the extent of loss under field conditions especially when ammoniacal fertilisers are applied as top dressings; whether the ammonia evolved from the soil is partly assimilated by the growing plant. The mechanism of loss, as also its bearing on other nitrogen transformations such as nitrification, also require elucidation. The mannner in which the added cellulosic materials check the volatilisation would also require some explanation. Attempts should also be made to minimise the loss under

different soil conditions without abnormally increasing acidity which would be inimical to most crops.

The foregoing and allied problems are now under investigation.

V. SUBRAHMANYAN.

Department of Biochemistry,
Indian Institute of Science,
Bangalore.

[1] Hutchinson, C. M., *Mem. Dept. Agric. India., Bact. Ser.*, 1910-11, **1**, 41.

[2] Sreenivasan, A., and Subrahmanyan, V., *Jour. Agric. Sci.*, 1935, **25**, 6.

[3] Cited from Sreenivasan and Subrahmanyan, *loc. cit.*, p. 20.

Observations on the Microflora of the Punjab Soils.

THE extreme temperature conditions in the Punjab, *i.e.*, very hot in summer and very cold in winter months present unique conditions for the study of the Soil Microflora. During the course of last year quantitative, and to some extent qualitative, studies were undertaken of Soil Bacteria, Fungi and Actinomycetes, in this subtemperate region of the globe. The most salient results may be summarised as under and the fuller details about them will appear in due course.

Soil Bacteria.—Fortnightly quantitative estimations, on Thornton's agar count medium (1922) have revealed that there are two maxima for the bacterial numbers in the Punjab soils, one towards the end of April or beginning of May, and the other is sometimes in October. Along with this there are two minima as well, one in the end of January and the other in the beginning of August. The bacteria hence show a marked periodicity in the different seasons of the year, though our maxima and minima are different from those reported by some of the European and American workers. The variations of the bacterial numbers in this soil cannot be explained entirely to be due to any of the physical factors individually, but may be the result of the accumulative effect of all the factors of which the temperature seems to be the most important. No extensive studies of the Soil Bacteria have been made but a spreading type was observed to appear and disappear at different seasons of the year, it being more prominent in spring and autumn and almost disappearing in winter and high summer. An extensive study, however, is desired for establishing definite conclusions on this subject.

Soil Fungi.—The quantitative estimations in the case of soil fungi on acid Coon's agar medium do not support the view that a definite periodicity in the numbers exist such as is found in the case of bacteria. The numbers seem to scatter about a mean value throughout the whole year. Various new genera of fungi which have not been reported before in the soil have been isolated, such for example, *Choanophora* sp., *Fusicoccum* sp., *Cytospora* sp., *Striochæte* sp., *Mapea* sp., *Stemmaria* sp., etc. Particular attention was paid to the occurrence of Aspergilli and Penicillia during the different seasons of the year. The results corroborate the view of Waksman (1932) and later by Galloway (1936) that Aspergilli are more abundantly found than Penicillia in the warmer soils, the latter being more prominent during winter months. The other common soil forms may be listed in the following order according to their intensities of occurrence. *Fusarium* sp., *Alternaria* sp., *Spondylocladium* sp., *Rhizopius* sp., *Mucor* sp., *Phoma* sp., *Trichoderma* sp., *Stemmaria* sp., *Monilia* sp., *Sordaria* sp., *Heterosporium* sp., *Mapea* sp., *Spicaria* sp., *Choanophora* sp., *Cunninghemella* sp., *Striochæte* sp., *Helminthosporium* sp.

Soil Actinomycetes.—Fortnightly estimations of the soil actinomycetes on alkaline Coon's agar medium show that they do not show any periodic phenomenon. The variations in numbers during the different seasons of the year can be accounted on the random sampling basis. It seems that fungi and actinomycetes are very resistant organisms and are not so readily affected by external conditions as the bacteria.

JAGJIWAN SINGH.

Department of Botany,
Government College,
Lahore,
April 22, 1937.

[1] Thornton, H. G., "On the development of standardized agar medium in counting Soil Bacteria," *Annals of Applied Biology*, 1922, **9**.

[2] Waksman, S. A., *Principles of Soil Microbiology*, 1932.

[3] Galloway, L. D., "Indian Soil Fungi," *Ind. Journ. Agric. Sci.* 1936, **6**.

The Occurrence and Inheritance of Purple Pigment on the Glumes of Sorghum Close on Emergence from the Boot.

SORGHUMS are divisible into two sects, *Para-Sorghum* and *Eu-Sorghum*.[1] In the *Para-Sorghum* group, in the species *Sorghum versicolor* J. N. Anderss, *S. diminiatum* Stapf and *S. purpureo-sericeum* Aschers. et Schweinf. the glumes though they emerge green in colour from the boot, turn purple the day after emergence. In the plants belonging to these species observed at Coimbatore, leaf-sheaths do not develop the purple colour.

In the *Eu-Sorghum* group to which all the grain sorghums belong, purple pigment manifests itself concurrently on the leaf-sheath and on the glumes when the factor P is present. This pigment is reddish purple or blackish purple according as the factor Q is present or not.[2] In the leaf-sheath the colour appears at the short-blade stage. The time at which the pigment appears on the body of the glume is about three weeks after emergence of the head, when the flowering is over and when grains are in the dough stage. Till then, the glumes are green.

In certain grain sorghums from Nigeria, belonging to the species *Sorghum guineense* Stapf and *S. caudatum* Stapf a new experience has been met with. In these varieties the glumes put on a purple colour just immediately after emerging from the boot. Even inside the boot the tops of the glumes are coloured purple. The manifestation of purple on the leaf-sheath takes place as usual, about the heading stage.

In *S. guineense* Stapf, crosses between Emerging Purple and Emerging Green types were made. The first generation showed the complete dominance of emerging purple. In the second generation there was a simple mono-hybrid segregation (47 emerging purple and 18 emergimg green). A third generation of four emerging purple and one emerging green selections was raised. The green was pure. Of the four purples two pure and the other two segregated giving 68 purples and 24 greens.

A new gene, G_{ep}, Nigerian in origin is responsible for the manifestation of purple pigmentation on the glume at emergence from the boot—an acceleration of the usual manifestation at the dough stage.

Since all the glumes turn purple at the dough stage, care was taken to note this character soon after the emergence of the head. After the dough stage the two groups keep on the same tint of purple. When awns are present, the subules take on the purple pigment when the glumes colour on emergence. The colour on the subules, however, fades on drying. Whether the colour manifests late or early on the glumes of the sessile spikelet, the pedicelled spikelets remain unaffected by the pigment.

The colour at emergence may be reddish purple or blackish purple and in family No. A.S. 4948 the following di-hybrid segregation, proving the independent inheritance of the factors Q and G_{ep}, have been obtained.

Selection No.	Glumes Purple at emergence G_{ep}		Glumes Green at emergence g_{ep}	
	Reddish Purple Q	Reddish Purple q	Blackish Purple Q	Blackish Purple q
A.S. 4948	67	21	21	7

To sum up: A factor G_{ep} imparts purple pigment to the glumes of sorghum immediately on emergence of the head from the boot. G_{ep} is a simple dominant to g_{ep} (manifestation of purple pigment at the dough stage) and is independent in inheritance to the Q factor determining the nature of the pigment, whether reddish or balckish purple.

G. N. RANGASWAMI AYYANGAR.
B. W. X. PONNAIYA.

Millets Breeding Station,
Coimbatore,
May 10, 1937.

[1] Snowden, J. D., *The Cultivated Races of Sorghum*, 1936.

[2] *Ind. Jour. Agric. Sci.*, 1933, **3**, 589.

Labial Glands in Coleoptera.

"LABIAL glands are present in all the principal orders of insects except Coleoptera," says Snodgrass (1935). Imms (1925) remarks "Although these glands appear to be often wanting in Coleoptera, they are present in the majority of insects and assume a great variety of form and

structure." My recent studies on the mouth-parts of the Coccinellid beetles, however, have revealed the presence of well-developed labial glands in *Coccinella septempunctata*. Subsequent search for these glands in more than half a dozen species has shown that probably labial glands are of universal occurrence at least in the family Coccinellidæ amongst the Coleoptera.

In *Coccinella septempunctata* (Figs. A and B) as well as in other species I have studied, these glands are paired structures opening separately at the base of the hypopharynx between it and the labium. Each gland consists of globular lobes with long fine ductules which open at various levels into a long thick common duct. The two common ducts of the two glands lie quite symmetrically on either side of the median axis of the labium.

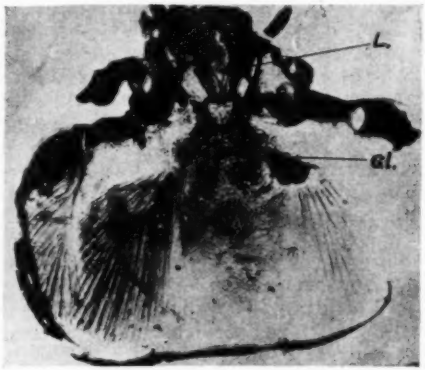


Fig. A.

Section of the head-capsule of *Coccinella septempunctata* showing the Labial Glands *in situ*. *L.*, Labium; *Gl.*, Labial glands.

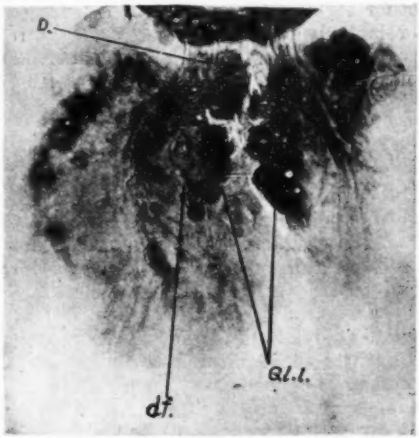


Fig. B.

Labial glands of *Coccinella septempunctata* photographed under the high power of the microscope. *Gl. l.*, globular lobes of the glands; *dt.*, ductules of the lobes; *D.*, main duct of the gland.

Besides these labial glands, there are also in *C. septempunctata* as well as in other species I have studied, very long, thin, tubular glands associated both with the mandibles as well as with the maxillæ. The structure of the maxillary and the mandibular glands is similar, and closely resembles that of the so-called salivary glands of Tenebrionidæ (Gupta, 1937), *Epilachna indica* (Pradhan, 1937), *Cœcilius* sp., fam. Psocidæ (Kolbe) and some other species of Coleoptera investigated by Dufour (1824).

My findings on these various glands lead me to two important conclusions: (1) that the labial glands are not always absent in Coleoptera, (2) that the so-called tubular salivary glands described in the Coleoptera by the various authors referred to above are not true salivary glands, homologous with those of a generalised insect like the cockroach. The second conclusion is based on the following considerations:—(*a*) the salivary glands of the generalised insect are true labial glands; (*b*) the tubular glands referred to as salivary glands by the various authors are clearly traceable in the Coccinellidæ to the bases of the maxillæ and the mandibles; (*c*) these tubular glands co-exist with the true unmistakable labial glands which show an absolutely different structure. Thus there is need to search for the true salivary glands even in those species in which the so-called tubular salivary glands have been noticed before.

The full paper containing a detailed description of these glands and further considerations on their theoretical significance will shortly appear elsewhere.

I wish to record my respectful thanks to Prof. K. N. Bahl and Dr. H. S. Pruthi for the indispensable help they give me in my research. My thanks are also due to M. L. Bhatia, Esq., for his kind help.

S. PRADHAN.

Department of Zoology,
University of Lucknow,
Lucknow,
May 5, 1937.

Serial Experiments.

THE review of 'A Hand-Book of Statistics for use in Plant Breeding and Agricultural Problems', by F. J. Shaw appears in the March issue of *Current Science*. About the illustration* in the section of Serial Experiments the reviewer (D. S. R.) writes, "The sum of squares due to blocks is taken as though there are 5 blocks, whereas there are actually 30 blocks. Because a block in Table XLVI is not identical in all the seasons and in the two localities in the sense that a variety is, the necessary correction should be made when using the book."

By suggesting a correction to write the S. S. for blocks as

	d. f.	S.S.
Blocks ..	24	5120·831
instead of as		
Blocks ..	4	197·774
Blocks × Localities	4	735·224
Blocks × Seasons	8	3175·232
Blocks × Seasons × Localities ..	8	1012·601

the reviewer only partially gets over the unreal difficulty of attaching meaning to such items in the analysis of variance table as depend for their meaning on the arbitrary numbering of blocks in different years and localities. There are four other items which depend for their meaning on the arbitrary numbering of blocks, namely

	d. f.	S.S.
Blocks × Varieties	48	1112·562
Blocks × Varieties × Seasons ..	96	2231·135
Blocks × Varieties × Localities ..	48	897·245
Blocks × Varieties × Seasons × Localities ..	96	1979·310

and if the correction is to be complete it is necessary to replace the four items by one single item, namely

	d. f.	S.S.
Error	288	6220·252

Although it is unnecessary to split the block S.S. (24 *d.f.*) and the error S.S. (288 *d.f.*) it is not incorrect to divide them in the way done by Shaw. The use of the word 'correction' by the reviewer is in this sense misleading.

A mistake has been made not in the analyses of Variance Table but in its interpretation in tests of significance. In an experiment in randomised blocks in which varieties are assigned wholly at random within each block, the degrees of freedom corresponding to the interaction between blocks and varieties are due to the differences in fertility between different plots within the same block and are therefore wholly available for providing the estimate of error. In the present illustration there will be 48 *d.f.* available for estimating the error in each of the six single experiments, and 288 (48 × 6) for estimating the error in the aggregate as against only 96 allotted by the author. By assigning only the third order interaction to the residual error, Shaw fell into the error of basing the error-proper on only a partial number of *d.f.* As a consequence of this the level of significance was much too raised and the tests were made more stringent than were originally intended.

In the example under discussion, the number of *d.f.* for error as shown in Shaw's book is already sufficiently large and there is no likelihood that any of his conclusions will be materially altered due to the rise in the significance level. But nevertheless it is of real value to guard against this mistake which may seriously affect interpretation in other serial trials where the *d.f.* for error are relatively few.

P. V. SUKHATME.
Imperial Institute of Sugar Technology,
Cawnpore,
April 16, 1937.

IN the review of the book under reference, there was pointed out the need for correction of the analysis of variance of a serial experiment therein discussed. Within the scope of a review, it was deemed expedient to just invite attention to the fictitious system of blocks employed in the analysis of the results, leaving it to those interested in the subject to make the necessary alterations. Dr. Sukhatme has now volunteered to set forth these alterations in detail. But it was unnecessary for him to have mentioned that "By suggesting a correction to write the S. S. for blocks as.....the reviewer only partially gets over....." Because, in the

* The illustration is taken from an actual experiment conducted by Mr. R. D. Bose, Pusa, and had originally appeared in the *Journal of Agriculture and Live-Stock of India*, **5**, Part VI.

the review there was not mentioned any specific correction but that the "necessary correction should be made" in the table after realising the fundamental error about blocks. As Dr. Sukhatme further expresses the view that these corrections are unnecessary, the argument is now furnished to urge the necessity for correction mentioned in the review.

The five blocks constitute an entirely fictitious system. *The numbering of the blocks as 1, 2,.....5 in any year or locality is perfectly arbitrary. To realise this, is to appreciate the contention that the concept of blocks as employed in the analysis conveys no meaning.* It follows then that every entry in the table associated with blocks, namely "Blocks", "Blocks × Localities", etc., is absolutely without meaning, and therefore not as good as being only "incorrect". The corresponding sums of squares must be absorbed in the true block and error sums of squares. This is not a matter of choice but one of absolute necessity.

If on realising the initial mistake about blocks the error sum of squares is recalculated to absorb "Blocks × Varieties", "Blocks × Varieties × Seasons", etc., there does not arise the further question raised by Dr. Sukhatme, namely, "A mistake has been made not in the analyses of Variance Table, but in its interpretation in tests of significance."

D. S. R.

April 30, 1937.

A Note on the High Insulation of Outdoor Antennas.

By C. V. Rajam.

(*Department of Physics, Presidency College, Madras.*)

THE condition of high insulation of an outdoor antenna is difficult to secure in practice and particularly in tropics where the atmospheric humidity and temperature are comparatively high. The problem becomes quite serious in a place situated near a tropical sea and great difficulty was experienced by the author at the Presidency College, Madras (situated very near the sea), in maintaining the insulation of a long outdoor aerial (used in the investigations on the waveforms of atmospherics) at any satisfactory value (above 10 megohms). Aerial insulators made of glass, pyrex glass and quartz were tried and found inadequate for the purpose. Though with pyrex and quartz insulators the aerial insulation was found high to begin with, in the course of a few days the insulation deteriorated so as to exhibit a diurnal variation with a maximum (quite high) at noon, and a low minimum (a megohm or even less) at the late hours of the night. On close study, it was found that the slow deterioration and the characteristic diurnal variation was due to the surface leakage, resulting from the surface film of moisture together with a small amount of dirt and salt formed over the surfaces of the aerial and lead-in insulators, and not due to any deterioration in their volume resistivity. The suitability of sulphur insulators for securing high insulation has been suggested by previous experimenters[1,2] but the details of the practical design and method of construction are found meagre in the literature. It is the purpose of this note to describe in detail the practical design and construction of a successful form of aerial and lead-in insulators made of ebonite and sulphur.

In the design of the high-insulation aerial insulators two principal conditions, namely, (1) high surface resistivity combined with adequate volume resistivity and (2) sufficient mechanical strength to stand the tension of the aerial wire, should be satisfied. Though sulphur possesses high surface resistivity it is not mechanically strong enough to be used in the form of aerial insulators and hence it is necessary to use it in the form of a coating or flange with another insulating substance like ebonite so that the insulator made up of the two substances may exhibit a high surface resistivity as well as sufficient mechanical strength. Ebonite is found most suitable for this purpose as it possesses good volume resistivity and exhibits a strong adhesive property towards sulphur while retaining it over a good range of temperature as the thermal expansion of sulphur and ebonite are more or less the same. It may be pointed out that unless the coefficient of the thermal expansion of the insulating material used in conjunction

[1] Wilson, C. T. R., *Phil. Trans.*, 1921, **221 A**, 73.

[2] Appleton, Watt and Herd, *Proc. Roy. Soc.*, 1926, **3 A**. 615.

with sulphur is very nearly equal to that of sulphur, cracks will be developed under the variations of atmospheric temperature and this will lead to a quick deterioration of the surface resistivity of the insulator. After experimenting with different designs and methods of construction the following was found most suitable for securing an aerial insulator with high surface resistivity and mechanical strength to stand the tension of quite long aerials.

As illustrated in Fig. 1 an ebonite rod of $2\frac{1}{2}''$ in diameter and about 9" in length is turned in a clean lathe to form three grooves each one measuring $\frac{1}{2}'' \times \frac{1}{2}''$ at a distance of $1\frac{1}{2}''$ from each other along the length of the rod. These grooves are cut to form the wide flanges of sulphur over a clean ebonite surface $\frac{1}{2}''$ below the general surface of the ebonite rod, as such a design imparts high surface resistivity and good mechanical strength to the wide flanges of sulphur.

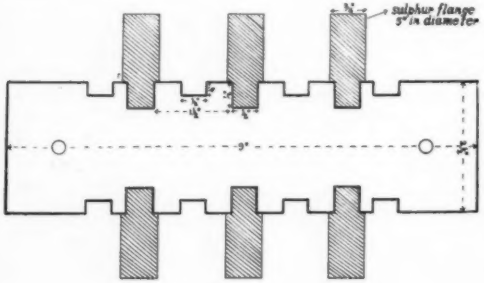


Fig. 1.

Between these three flange grooves, three more shallow grooves measuring $\frac{1}{2}'' \times \frac{1}{4}''$ are cut so that the continuity of the ebonite surface between any two sulphur flanges is intercepted by a shallow groove. Two more shallow grooves are cut at a distance of $1\frac{1}{2}''$ from each end of the rod for the same purpose and the holes for the aerial are bored beyond these grooves as shown in Fig. 1.

The formation of the wide flanges of sulphur measuring 5" in diameter and $\frac{3}{4}''$ thick around three deep grooves on the ebonite rod should be carried out carefully so that they are finished without any internal pores or cracks while at the same time having a highly polished surface. The above two qualities of the sulphur flanges are found essential to secure the highest surface resistivity to moisture as well as the constant high insulation property of the insulator as a whole. For this purpose a polished metallic mould in the form of a shallow circular vessel (5" in diameter and $\frac{1}{4}''$ depth) having a central hole just allowing the ebonite rod to pass through it, is fixed round one of the three deep grooves. Sulphur which is melted in a clean vessel is poured little by little in the mould so as to form a uniform non-porous flange from the full depth of the groove. The sulphur used for this purpose should be pure in the form of rolls and it should be melted in such a manner as to avoid the formation of red sulphur which is found detrimental for securing the best insulating properties of the sulphur flange. By heating the sulphur in a wide vessel over a sand-bath and keeping always an excess of solid sulphur in the melting pot it is easy to avoid the formation of red sulphur. Again only a small quantity sufficient to form a thin layer of the flange should be poured at a time to avoid any pores in the flange and after allowing it to solidify the process should be repeated to form the required thickness of the flange. After allowing the sulphur flange to solidify and cool for about three hours the mould is easily removed leaving the sulphur flange firmly adhering to the ebonite rod and in this manner the other two flanges are formed. The aerial insulator with the properly formed sulphur flanges around the ebonite rod exhibits remarkably high insulating properties and mechanical strength under all conditions of the weather. A photograph of this high insulation aerial insulator is shown in Fig. 2.

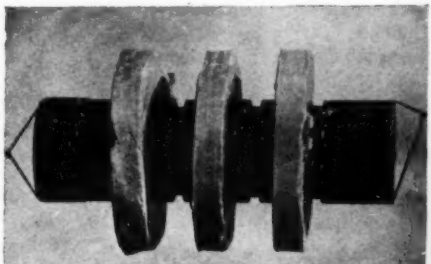


Fig. 2.

The lead-in insulator to be used with the above aerial insulators is also designed and constructed on similar lines. In this case (Fig. 3) an ebonite disc of 9" diameter and $\frac{3}{4}''$ thick is taken and leaving a central plat-

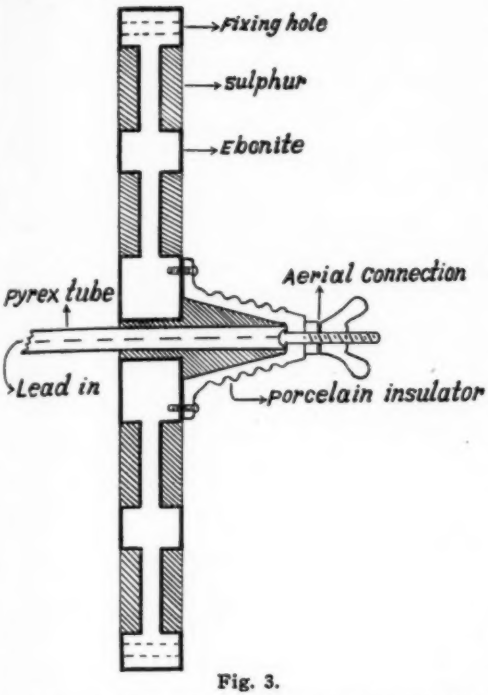


Fig. 3.

form of about 2″ diameter, two concentric grooves measuring $1\frac{1}{2}'' \times \frac{1}{4}''$ are turned on both the surfaces of the disc. The grooves are filled with pure sulphur in the manner already described and the central platform is fitted with a high grade porcelain or pyrex glass insulator as illustrated in the figure. The lead-in insulator from the terminal of the porcelain insulator is taken through a pyrex glass tube passing through a central hole in the ebonite disc and being fixed in position by the sulphur filling the space around the tube. This lead-in assembly is fixed to a window pane in which a hole of about 8″ diameter has been already cut so that the surfaces of the sulphur rings or the lead-in tube do not touch the earthed surface. The system of aerial insulation consisting of a pair of the ærial insulators and a lead-in insulator as described above has been found quite efficient in maintaining the insulation of an outdoor antenna at a very high level without any appreciable diurnal or seasonal variations.

It may be added here that the insulators constructed on similar lines with sulphur and ebonite to suit the requirements of precision electrical measurements in a laboratory are found quite successful in securing a very high insulation by avoiding the troublesome surface leakage experienced in the moist atmosphere of a laboratory situated in tropics.

A Note on Hairiness in the Punjab Cottons.

By R. S. Jai Chand Luthra.
(*Punjab Agricultural College, Lyallpur.*)

IN the Punjab, the aim for improvement of cottons has been the introduction of strains with lint of better quality and longer staple than the indigenous types. For this purpose greater attention was devoted to American cottons and a large number of them were put down for trial. After some experience of these varieties, it was realised that those with glabrous leaves got severely attacked by insects. Examination of the surface of leaves of a number of American cotton selections and indigenous types showed a marked difference in the extent of their hairiness and texture. Such variations among other causes were believed to be responsible for the difference in the degree of injury done by insects.

In this note, some observations made on the following points are presented :—

(*a*) Forms of hairs and their length.

(*b*) Intensity of hairiness.

(*c*) Thickness of leaves.

(*a*) *Forms of hairs and their length.*—There are two kinds of hairs found on the leaves of cottons, *viz.*, (i) branched, and (ii) unbranched. They are all unicellular. They lie on the sufrace and are closely pressed together in a tangled mass forming a loose felt-like covering. This is particularly noticeable in indigenous cottons. The branched hairs are of stellate form with rays varying from 2–8. In cetrain cases branches proceed in one direction only and form a tuft (Fig. 1).

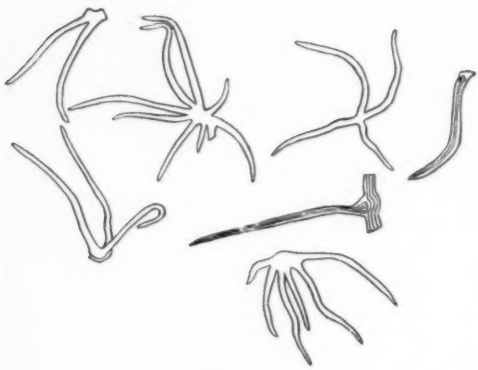


Fig. 1.
Forms of Hairs on Leaves of the Cotton Plant.
(Diagrammatic.)

Length of hairs.—Small pieces of epidermis were peeled off full-grown leaves from various parts of the lamina and the length of hundred hairs, taken from different portions was measured with an Ocular micrometer under low power.

TABLE I.

Length of hairs in m.m. (average of 100 hairs) in different American and Desi varieties of cotton.

	Type	Upper surface	Lower surface
Punjab American types	1	1·07	·97
	4–F	1·07	1·05
	4-F(S)	1·13	1·03
	6	1·15	1·09
	35	1·09	1·01
	38	1·23	1·03
	19	1·15	1·03
Indigenous types	*G. Indicum*	·97	·92
	Mollisoni	·93	·89

(*b*) *Intensity of hairiness.*—Hairs present on the upper and lower surfaces of full-sized leaves of important American cotton types and also on some *Desi* varieties were examined and counted under a low power objective No. 3. The data given in Table II are averages of counts made on ten leaves and are expressed on one square centimetre area.

The table shows that there is a great range of variation in the hairiness in the American cottons. Types 1,43,4-F and 4-F (S) are more hairy than the rest. The *Desi* cottons bear 50–100% more hair than American cottons.

TABLE II.

Number of hair per sq. cm. in different types of American and Desi *cottons.*

	Upper surface		Lower surface
	Type	Average	Average
Punjab American types	1	660 ± 12·8	652 ± 167
	43	549 ± 10·5	733 ± 15·0
	4–F	600 ± 23·7	558 ± 22·1
	4–F(S)	545 ± 14·0	547 ± 15·2
	35	221 ± 16·3	331 ± 20·8
	38	231 ± 15·3	238 ± 16·4
	6	455 ± 18·6	515 ± 19·6
	19	220 ± 15·6	178 ± 11·0
Indegenous types	*G. Indicum* proper	1051 ± 21·8	998 ± 17·6
	G. Indicum Mollisoni var.	1365 ± 18·8	1253 ± 20·6

(*c*) *Thickness of leaves.*—Another character of importance is the thickness of leaves.

TABLE III.

Showing the thickness of leaves of a few selected types (measurements were made on ten leaves in each case).

Type	Thickness of the leaf in microns
1	296 ± 25·1
4–(F)	281 ± 24·0
38	255 ± 33·4
43	272 ± 31·8
Mollisoni	178 ± 16·0

A comparison of Tables I and III would show that American types have thicker but less hairy leaves than indigenous cottons grown in the Punjab.

1. Afzal, M., *Ind. Jour. Agric. Sci.*, 1936, **6**, Part III.

2. Berger, E. W., *University Florida, Agri. Expt. Bull.*, 1910, No. 103.

3. Husain, M. Afzal, *Agric. Jour. Ind.*, Nov. 1930, **25**.

4. Roberts W., *Agric. Jour. Ind.*, March 1929, **24**.

5. Youngman, W., and Pande, S. S., *Ann. Bot.*, Oct. 1929, **43**.

6. Solereder, H., *Systematic Anatomy of the Dicotyldons* 1908, **2**.

7. Kerner and Oliver, *The Natural History of Plants*, 1894, **1**.

REVIEWS.

Men of Mathematics. The Lives and Achievements of the Great Mathematicians from Zeno to Poincare. By Dr. Eric T. Bell. (Simon and Schuster, New York), 1937. Pp. xxi + 592. Price $ 5·00.

This book belongs to the interesting series of works like *Men of Arts*, *The Story of Philosophy* and *Green Laurels* published by Messrs. Simon and Schuster, and forms a worthy contribution to "the conscious adventure of humanising knowledge". Professor Eric Bell has, with conspicuous success, accomplished a great and worthy task for which he is eminently fitted, and this work will always remain as one of the finest biographical treatises published in recent years. Primarily this is addressed to the general reader who may desire to discover what sort of men the mathematicians were who built up the modern science, and it is bound to have a deeper interest to those who profess this science. In selecting the lives of twenty-nine mathematicians, Prof. Bell was mainly guided by two considerations, *viz.*, the significance and influence of one's work on the development of modern mathematics, and the intense human appeal which one's life and character make to the reading public. The book is not a treatise on mathematics, but its interest lies in the story of the lives and personalities of the great creators of modern mathematics, who frequently lived strange lives as soldiers, theologians, diplomats, lawyers, mystics, drunkards and charlatans. Human character acquires a charm and attractiveness through its unconscious foibles, and great men through ages would seem to have suffered from endearing frailties.

It is almost impossible to deal with the lives of mathematicians without special reference to their ideas and contributions, and Prof. Bell has made it so easy for the general reader, equipped with no more than a modest measure of mathematical training, to follow such topics as "Groups", "Space of many dimensions", "Non-Euclidean Geometry" and "Symbolic logic". Other topics in which the general reader is likely to be interested in following the contemporary scientific thought are, the doctrine of the infinite, imaginary members, the mathematics of general relativity and the theory of probability; and these subjects are treated for the benefit of the general reader, with an emphasis on their importance on modern thought.

The historical development of mathematics may be traced through four distinct phases, *viz.*, the Babylonian, the Greek, the Newtonian and the Recent. Two great advances, *viz.*, analytic geometry and the calculus gave great impetus to the growth of modern mathematics. Though Prof. Bell does not attempt anything in the nature of chronological development of mathematical science, he has kept the evolution of great ideas and abstract concepts which underlie its progress in the foreground of the treatment of the lives of their authors. The fundamental fact about mathematical science is that the ideas and inventions which were formulated tens of centuries ago, still maintain their influence and importance in modern work. It is hardly conceivable to form an estimate of what modern mathematics has achieved as compared to ancient, and even considering the mere bulk, the volume from 1800 would, it is supposed, cover 20 times the size of Moritz Cantor's *Geschichte de Mathematik*. The nineteenth century is the Golden Age of mathematics.

Commencing in the first chapter with Zeno, whose paradoxes puzzled the philosophers of ancient Athens, Eudoxus and Archimedes, the greatest scientist of antiquity, Prof. Bell treats of Descartes in the next chapter. The succeeding chapters deal with Fermat, Pascal Newton, Leibniz. The Bernoullis, Euler, Lagrange, Laplace, Monge and Fourier, Poncelet, Gauss, Cauchy, Lobatchewsky, Abel, Jacobi, Hamilton, Galois, Sylvester and Cayley, Weierstrass, Boole, Hermite, Kronecker Riemann, Kummer and Didekind, Poincaré and Cantor. A more judicious selection of great masters could not have been made, and each chapter presents a warm and vivid picture of the life and labours of these great men, portrayed with a wealth of colour and a mass of detail true to the originals.

The science of mathematics underlies and embraces all branches of knowledge, whose progress is determined and whose

conclusions are rendered precise by the extent to which the results of investigations become capable of being mathematically expressed. Few who have followed the rise and expansion of scientific knowledge within recent times, will fail to appreciate Galileo's saying that "Nature's Great Book is written in mathematical symbols".

The book is a veritable mine of information, as important as fascinating. The author treats of ideas with the same ease and sympathy as he treats of their originators. The essence of the book lies in the personalities of the great creators of modern mathematics, and every one interested in the progress of great scientific developments either in the theoretical or applied branches of knowledge, will welcome this important work which considered even as a literary contribution is entitled to unstinted praise. The illustrations are excellent.

Comets, Their Nature, Origin and Place in the Science of Astronomy. By Mary Proctor and Dr. A. C. D. Crommelin. (The Technical Press, Ltd., London), 1937. Pp. 203. Price 8*s*. 6*d*. net.

This interesting book must be a welcome addition to the large number of works on the subject of Comets. These Heavenly apparitions when they appear fill men's minds with fear and wonder. To the astronomer they offer interesting and perplexing problems, regarding their origin, motion and behaviour. The first chapter discusses briefly the theories concerning the origin of comets, and refers to the comet families of the giant planets. Spectroscopic evidence and the fact that comets are under the influence of gravitational force tracing elliptical orbits, favour their solar origin, but it is also possible to consider that they had their birth in the same common cosmic material out of which the solar system has grown. But the final answer can hardly be presumed to have been given by Science. The large planets such as Jupiter, Saturn and Neptune have quite a number of comets attached to them, and possibly the planets themselves may have been their parents. The existence of planets forming planetary families can scarcely be explained without assuming the ejection from these giant bodies of masses of matter akin to those thrown off from the surface of the Sun during periods of eruption. The first chapter concludes with an interesting history of the Grigg-Skjellerup Comet, one of the late additions to the Jupiter family. The most interesting fact about this comet is its shortest period of any known comet, with the exception of Encke's.

Three chapters out of eight in the book are devoted to the consideration of the work and results obtained by the famous "Comet Hunters" such as Louis Jean Pous, John Russell Hind, John Tebbutt, William Frederick Denning, William Reid and Alexander Forbes-Irvine Forbes whose pioneer labours, which, apart from the romantic element attached to them, laid the foundation of the scientific study of these mysterious and elusive Heavenly bodies.

The story of Halley's Comet which is dealt with in two chapters, has a special appeal both from the historical standpoint and from the fact that it has enabled astronomers to trace the path of comets in general. This comet appeared in 1910, first as morning and later as evening star, and those who observed this visitant can never forget that among the splendours of the Heavens, there was nothing to surpass this in its baleful magnificence. The bright comet which was seen both in Greece and in China in 467 B.C., of which there is no clear account, was probably Halley's Comet, which was due about that year, and its next appearance, according to the list of its returns, is about February 1986.

In the last chapter there is a full discussion of the "Capture Theory" whose untenability was first shown by Richard A. Proctor.

For the benefit of non-technical readers there are short notes on Ellipse and Elliptical motion of Heavenly bodies, how a comet's orbit is deduced from observations and hints for amateurs interested in the search for new comets. There are good diagrams illustrating the orbital motion, together with the relative position of certain well-known comets to the constellations. The frontispiece is an excellent reproduction of Halley's Comet photographed by Professor E. E. Barnard on 4th May 1910.

The story of the Heavens always fascinates human imagination, whether cultivated or ignorant, and this book is a romantic chapter in that glittering story. The

general reader will find in it both romance and Science.

The Wandering Spirit, A Study of Human Migration. By Ragnar Numelin, Ph.D., with a Foreword by Dr. Edward Westermarck. (Macmillian & Co., Ltd., London), 1937. Pp. xvi + 375. Price 20*s*. net.

Students of Social Anthropology will welcome this book as a solid contribution to their science. The book also holds a great interest for the general reader. It presents a general analysis of the leading causes which have governed the large-scale movements of peoples in the earlier stages of civilisation, and has attempted to bring within the compass of a single book, information scattered through an extensive range of literature. Reference to literature covers 45 pages of the book, and the researches of the author have led him not into the fields of philosophical speculation, but to formulation of a sociological explanation of the factors involved in determining human wanderings. His studies of the present-day savages in whom the primitive instincts and impulses might be found in the most natural state, occupy the greater part of the book, and the author deduces from such studies the general reasons underlying migrations. He points out that although the original causes which impelled the primitive groups to vagabondage, have ceased to exist, still the spirit of wandering has become second nature to people such as the gypsies, to whom the author has devoted an interesting chapter.

The wandering instinct in man is part of his animal inheritance, and it occurs in a strongly typical form in those primitive groups who have remained in the most natural state. This spirit is controlled in human communities practically by the same factors which govern and regulate the large-scale migrations of animals—*viz*., "subsistence—geographical reasons". As civilisation progresses and the conditions of social life become stabilised by economic and political relations, this instinct undergoes gradual transformation, and until finally it is rendered subconscious. The consolidation of human societies implies the elimination of natural forces which operate almost in an unrestrained fashion among the ruder forms of communities. Primitive human groups are exposed to the vicissitudes of the natural conditions of existence, not widely different from those under which animals live, and therefore they must be subject to the same impulses which move the lower animals to seek readjustment and adaptation to environmental factors.

The object of the author in investigating the problem of the wanderings is not to reach a definite solution, but to examine the several hypotheses with a view to test their validity, and in doing so, he has formulated certain general conclusions regarding the wanderings of peoples, their secondary manifestations and complicated cases of migrations. It is pointed out that the migrations of primitive people are movements without any definite aim and are guided by the wandering spirit which is part of their nature, while the migratory movements of civilised man are governed more fully by well-defined ultimate considerations of welfare. As the great movements of the primitive tribes took place in early historical times, when no one was at hand to investigate their causes, it must be a matter of speculation as to the reasons underlying those mass migrations. Generally speaking, the causes which lead to migrations of societies of people whatever may be their state of civilisation, are abundance or absence of food and sudden and wide changes of climatic conditions, periodic occurrences of disastrous floods, earthquakes and similar manifestations, repeated appearance of pestilence, insect plagues, tribal incursions and inability to repel them, better attractions and advantages of neighbouring districts, offering a more generous supply of food, greater security and protection of the young and the defenceless members of the community and mitigation of the rigour of climate. In the case of civilised communities, there are other factors such as, expansion of trade and commerce, extension of the sphere of political influence, scientific explorations, and above all the desire and tendency for spreading the blessings of civilisation and Christianity among the heathens, which have led to migrations, peaceful penetration, and final absorption of foreign territories. To a large extent, the power that science has conferred on civilised man to control the influence of nature, has altered the conditions of survival in the struggle for existence, such as operate among the primitive societies, and at the same time it has

placed in the hands of modern man the means of destroying civilisation.

We agree with the author that the primary cause which impelled the primitive man to move from his temporary settlement must be the subsistence—geographical factor, to which may be added the spirit of curiosity and exploration inherent in man, irrespective of his scale of civilisation. The natural forces being brought under scientific control, modern man is solely guided by the spirit of adventure, stern economic necessity and restlessness to use his powers against defenceless people in his wanderings or in his quest of new lands for colonisation.

The migratory movements of lower animals are not strictly analogous to those of the primitive tribes of mankind, although the causes which impel both may not be widely different. The lower animals after their seasonal journeys, however long, always return to the place from which they started. This is true of several groups of animals. But primitive man when once he left his old home, ceased to think of returning to it, unless the new one proved undesirable and inhospitable. Animals seem to preserve the homing instinct while it was probably absent in primitive man, unless the old home had irresistible attractions for him.

The nomadic habits of certain tribes such as the gypsies are capable of a different explanation. Civil strife, overpopulation, unsettled condition of public life offering opportunities for the practice of criminal propensities, and the prospect of driving petty trade or playing on the credulity of unsuspecting people for personal profit, must have been the basis of the roaming spirit of all the nomadic people. Lust of unlawful gain and anti-social proclivities underlie tribal movements, and in the course of a few generations the habit of roaming about becomes ingrained in these people as an instinct.

It is almost impossible to give in the course of a review an idea of the range and variety of the enquiry pursued by the author and the very interesting results summarised by him in the book. The book throws fresh light on some of the obscure problems of the great movements of peoples in the infancy of civilisation, affording material for arriving at a correct estimate of the kindred problems of racial and cultural affinities. This volume is a critical summary of a whole library of books, and it is at once illuminating and stimulating.

Milk, The Most Perfect Food. By Prof. Dr. N. N. Godbole, Benares Hindu University, with a Foreword by Pandit Madan Mohan Malaviya. 1936. Pp. xvii + 137. Price Rs. 3, foreign 6*s*. inclusive of postage.

This is an excellent treatise, worthy to be in every household. Prof. Godbole has approached his task in a scientific spirit and in the performance of it he displays the commendable zeal of the convinced advocate of the principles he wishes to propagate. Besides references to the value of milk as an article of diet in the ancient Hindu literature, he deals with every aspect of this product in a simple and direct way. There are interesting chapters on allied topics such as Tea and Coffee and there are others devoted to a brief consideration of alcoholic beverages. A separate chapter is given to the examination of the relative value of vegetarian and non-vegetarian diet, and the last chapter provides comparative tables of food values. The chief merit of the book is the simple and honest way in which it treats the subject, and the author wishes India to go back to her ancient milk-mindedness, which seems almost to underlie her culture and civilisation.

A modern reader of the book is likely to be assailed by certain doubts, which perhaps he might put in an interrogative form and, presumably the author must have answers to such doubting Thomases.

Is there a Sanskrit saying which places man on a level with animals in respect of "food, sleep and procreation"? If it does, do adult animals use milk as an article of food? Are there people who have never touched milk in their adult life, and who, however, are strong, healthy and enduring?

"*Ahimsa*" is "*Parama Dharma*". Well, do vegetables have life? Do they suffer when they are cut and cooked?

Is protoplasm meat? Is there protoplasm in the vegetable tissues? If so, does this differ from the protoplasm of animal tissues? Is there a Sanskrit saying meaning, 'life subsists on life?'

Did the Aryans who gave the world *Vedas* and laid the foundation of *Dharma*

Sastras, eat meat and drink wine? What does the chapter on food in *Manu Dharma Sastra* say in the matter of flesh diet? Is it ethically justifiable to rob the cow of her milk, intended by her Creator for the exclusive use of her calf, and will it not involve "*Himsa*" both to the mother and her offspring?

These questions and sundry others of a similar character might appear ridiculous and impractical, but when one becomes dogmatic and even meticulous in laying down canons in the prescription of articles of diet, supported by scriptural authorities, then one is bound to encounter with such questions. The problem of food is essentially a matter of racial prejudice, and predilection and the choice of its articles is governed largely by traditional habits and instincts. Departure from such habits is almost entirely due not to perversion but to the innate tendency to reversion to more primitive tastes, stimulated by modern chemical discoveries.

The Clear Mirror (A Pattern of Life in Goa and Indian Tibet). By G. Evelyn Hutchinson. (Cambridge University Press), 1936. Pp. 171 and Plates XIII. Price 8*sh.* 6*d.*

This quaint little travel book is an account of the religion, art and natural history of the places visited by the Yale North Indian Expedition in 1932. Mr. Hutchinson who went as the biologist of this Expedition has attempted not only to describe in detail all that he saw and experienced, but also to give in the course of the composition some thought-provoking digressions so essential for a profitable travel narrative.

At first the focus is the mediæval Portuguese Settlement of Goa on the West Coast of India, and afterwards the bleak semi-desert of Indian Tibet. The description which derives its main substance from the religious and artistic culture of the inhabitants of these places combines in lucid style the natural history of the terrain and in consequence the text is not without scientific and literary value. Buddhism which flourishes with a predominant following in Indian Tibet, where Islam is struggling for a bare existence with a few adherents, is a rich store-house of ritual and ancient customs. Numerous instances are to be found in the book where the more important of the Buddhist religious rites are recorded in intimate detail which make highly interesting reading. An amusing superstition current in the Chang-Chenno District of Indian Tibet is about the *Panthelops*, the peculiar Tibetan antelope. This animal which is confused with the legendary unicorn, as the beast appears in profile to have but one horn, is reputed to be so delighted at the sight of a virgin that it comes and puts its nose in her lap. In this way the animal could be easily caught.

The book, which is rich with the fruits of a successful expedition into lands of which little is known to the lay reader, comprises all the elements derived from art, religion and natural history of the places visited and preserves alike those "mind-disturbing" qualities characteristic of great travel books.

C. N. R. RAU.

Television, A Guide for the Amateur. By S. A. Moseley and H. McKay. (Oxford University Press), 1936. Pp. 144 with 50 figures and 31 plates. Price 5*sh.* net.

In Europe and North America, the first steps towards achieving a national television service have already been inaugurated. To the ordinary person, the mystery of the scientific laboratory of yesterday has assumed at present the glamour of novelty. And beforelong, the novelty will no doubt wear off, and a television service will be taken as much for granted as sound broadcasting is at present. Interest in television is no longer confined to the scientist and the engineer; the mass of the people share it.

This book is therefore appropriately designed for the general reader with little technical knowledge. In the twelve chapters covering a little less than 150 pages, the essential elements of the theory and practical apparatus of television are described briefly in simple, straightforward terms. The first chapter on the scanning of a picture is followed by a discussion of the mechanical and electronic methods of scanning; by the use of the scanning disc and mirror drum on the one side, and the ingenious iconoscope of Zworykin and the dissector and multiplier of Farnsworth.

Television reception takes up the greater part of the book. The cathode-ray tube is described in considerable detail, including electron optics, time bases, etc. The difficulties of light control and of producing

pictures of the size of a cinema screen are explained clearly. The use of hyperaudio frequency waves travelling in liquids is a highly original and most ingenious method due to Jeffree. The description of mechanical methods of reception refer to the Scophony mirror-screw and the Mihaly-Traub devices and the modifications in them. The last chapter deals very briefly with the two television transmitters in London, the Baird and the Marconi—EMI. The book closes with a few useful pages of brief explanations or definitions of the terms used in television.

There are 31 beautifully reproduced photographic plates, a number of line diagrams and no mathematics. The language is simple and the descriptions accurate. The printing is excellent and free from errors.

On page 81, line 6, *contol* should obviously be *control*.

RE

Elements of Electricity. By W. H. Timbie. Third Edition. (John Wiley & Sons, Inc.), 1937. Pp. x + 569. Price 15 *sh.*

The book is intended for technical students and is designed to give them a clear grasp of the principles governing the working of electrical machines and the simpler calculations needed in understanding quantitative relationships in their design and working. It is not a purely technical treatise in the sense of dealing with details of technical design. In writing the book, a certain amount of preliminary knowledge of first principles of electricity and magnetism seems to be anticipated. The quantitative treatment is elaborate and richly illustrated at every step by examples worked out and problems set. This must be considered a special and valuable feature of the book. Calculus methods are rigidly avoided, though it sometimes results in a little circumlocution as in the treatment of inductance and the theory of alternating current circuits. Since the lower grades of technical students could scarcely be expected to carry their studies to the standard adopted in the book, this omission was not really necessary, and the kind of students who could profitably use this book, would have easily understood the elements of calculus that might have been employed usefully. This is the more so, as the mathematical treatment including the use of trigonometric functions and graphical and vector methods, is fairly elaborate. However, this point need not be unduly emphasised.

The treatment covers the most essential points of interest to an electrical engineer, such as the properties of electric, magnetic and electrostatic circuits and of the materials employed in such circuits, the construction and action of different types of generators and motors, power transmission problems, alternating current circuits embracing inductive and capacitive reactances, storage batteries, etc. The chapter devoted to thermionic phenomena including thermionic valves and their uses, X-ray tubes, gaseous rectifiers, and photoelectric effects will no doubt be found very useful by electrical engineers working under present-day conditions. The treatment of the different subjects is greatly assisted by a wealth of diagrams, figures and graphs. A noteworthy point is the attention devoted to clear definitions of units, emphasised by examples in their use. One misses a description of the construction and working of an important class of instruments, the measuring instruments such as ammeters, voltmeters, etc., though their use is indicated from the first chapter onwards. The answers to problems are given in a separate booklet. The printing and get-up is very good and there are practically no errors or misprints.

On the whole there is no doubt that the book will be of great use to students of electrical engineering. The standard may not be high enough for those undergoing a degree course, but the book offers a very clear grasp of first principles even to them.

A. VENKATA RAO TELANG.

Radioactivité. par Mme. Pierre Curie. (Hermann et Cie., Paris), 1935. Pp. 563; 170 figures and 26 plates. Price 150 *fr.* (Paper covers).

This is an exposition of the lectures delivered by Mme. Curie at the Sorbonne for a number of years, during the course of which the treatment has been continually modified to take the progress of the science into account. The book is divided into two parts. The First Part occupying 125 pages deals with the various investigations that have led to our knowledge of atomic structure such as ionisation of gases, properties of gaseous ions, cathode rays, positive rays, X-rays and the theory of quanta. With

this well provided background, the Second Part plunges into a detailed treatment of the subject of Radioactivity. Here we have a detailed description of the various radioactive families, and the radiations emitted by them. Induced radioactivity and nuclear transformations find their natural place as organic parts of the whole subject. Being a treatise intended for students, subjects, which are not yet fully developed and contain controversial results, such as nuclear structure, are not treated. For the same reason references to original papers are not given, but books for consultation are mentioned and the various results are described with references to their authors and the history of their development. The treatment is mainly experimental. Elements of the necessary theory are given, but even in such a case as the scattering of α-particles the steps are only sketched and the details of the mathematics are not developed, while in the case of Gamow's theory of the emission of α-particles, or the Klein-Nishina formula for the scattering of γ-rays, even the bare outlines of the reasoning are not described. As can only be expected from the authorship, the description of the experimental side is masterly and in each page we meet with remarks to which an investigator in the field would be ever grateful for their help in removing some perplexing difficulty in his path. The tables at the end of the book would also be eagerly welcomed by workers in the subject. One strong and admirable feature of the book is the wealth of illustration, most of the plates being models of clarity and beauty. They should serve also as examples of the perfection of technique to be aimed at by a student of the subject. In most cases the figures have legends attached which serve to describe the whole experimental technique. Sometimes this is all that is given: such is particularly the case when the author is dealing with some interesting side topic not directly connected with the main theme. There are a number of such interesting glimpses into other important branches of study, *e.g.*, the Coolidge X-ray tube, the triode valve, Hertz's apparatus for determining ionisation and excitation potentials and so on. In a very few cases modern results are not quoted but earlier investigations are mentioned. For example, in the separation of isotopes, Hevesey's older investigations are mentioned but the successful separation of isotopes by Hertz is not referred to. Aston's older form of mass-spectrograph is described, but not the improved form. It is a pity that such an extensive book should not have an index. The book has only paper covers as is the usual French practice. We have noticed a few misprints here and there, but the printing is, on the whole, good. Taking a view of the book as a whole we find that the First Part deals with subjects on which we have excellent English books, but the mastery and individuality displayed in the Second Part make the book unique. We heartily recommend it to all students of the subject. Those who intend to embark on original investigation in the field ought to digest the whole of this masterly exposition.

T. S. S.

A Text-Book of Physical Chemistry. By S. J. Smith. (Published by Macmillan & Co., Ltd.), 1936. Pp. 354. Price 5*s.* 6*d.*

This book would serve admirably as a text-book of physical chemistry for the B.Sc. (pass) students of Indian Universities.

In the Preface, the author has rightly pointed out that recent advances in physical chemistry "demand an extreme tolerance of new hypotheses and a restrained scepticism of what have been regarded as almost undisputed theories" and by tracing the historical development of certain topics he has indicated not only the utility and scope but also "the limitations and arbitrariness of both theories and definitions".

Attention may be drawn to the following commendable features of the book. The principles underlying the determination of atomic weights have been clearly stated. Treatment of optical activity and the principle on which the polarimeter is based is good. As stated in the Preface "those branches of physical chemistry which have important technical applications—for example colloids, catalysis—have been discussed irrespective of examination requirements". The industrial applications of catalysis—notably hydrogenation of oils and of coal—have been thoroughly dealt with. Other topics that have received adequate attention are the electronic theory of valency, dipole moments, electrode potentials and the theory of indicators. A number of problems have been worked out in the text and

students as well as teachers would no doubt welcome the carefully selected questions at the end of each chapter.

When an attempt is made to deal adequately with the topics discussed, it is but inevitable that certain other topics should be crowded out of a book of moderate size. All the same one is rather disappointed to find in the book no mention of the liquefaction of gases or of freezing mixtures, or of the effect of a third substance on the critical solution temperature of two liquids.

Certain inaccuracies have crept into the text and there are also some noteworthy omissions. On p. 225 the complex copper ammonium ion is indicated with two negative charges. It is hardly correct to assign to a jelly of gelatin a honeycomb structure (p. 157). On p. 298 in describing the calomel electrode no mention is at all made of the paste of calomel with which the mercury in the electrode is covered. It is difficult to maintain that chamber crystals constitute the intermediate compound in the production of sulphuric acid by the chamber process. On page 309 it is desirable to state that for moderate concentrations of a catalyst, the increase in velocity of the reaction is directly proportional to the mass of catalyst employed; for, the average student is likely to carry away the impression that a mere trace of catalyst need be employed in actual practice to secure adequate increase in the velocity of a chemical reaction. It is doubtful if the comparative stability of lyophilic colloids towards electrolytes (p. 162) can be correctly accounted for by stating that the large number of water molecules (associated with the colloids) "exert a stabilising influence by preventing the near approach of the precipitating ions". On p. 287 the diagram of the dropping mercury electrode is inaccurate. For successful work it is very necessary that the mercury stream should break into spray just below the surface of the solution. The mechanism of negative catalysis given on p. 318 is not the only one that can account for the phenomenon.

In spite of these minor blemishes the book is very suitable as a text. It is moderately priced and can heartily be recommended.

B. S. Rao.

Recent Advances in Cytology. By Dr. C. D. Darlington. Second Edition. (J. & A. Churchill, London), 1937. Pp. 670.

Modern cytology has progressed very considerably in the brief space of five years since the publication of *Recent Advances in Cytology* by Dr. C. D. Darlington. The Second Edition of this valuable book will, therefore, be welcomed by every student and research worker, who wishes to keep in touch with the latest developments in the study of nuclear mechanism, especially with those aspects of it that have a direct bearing on genetics. "It is perfectly possible that *Recent Advances in Cytology* marks a turning point in the history of Biology," says Prof. J. B. S. Haldane in his Foreward to the book. Coming from Prof. Haldane, this remark is very significant.

Cytology, which until recently was chiefly interested in the description and enumeration of simple observations, has principally by the stimulus given to it by Dr. Darlington, developed into an almost exact science wherein each cell process is shown to be connected with every other cell process and their causation shown to be due to the working of forces which are identical in animal and plant tissue.

That meiosis is an abnormality of mitosis and the origin of sexual reproduction was shown by Dr. Darlington in the First Edition of his book. In the Second Edition he has recast the whole account of chromosome behaviour in terms of Evolution and presented further evidence to show that uniform behaviour of nuclei make deduction and predition possible. Special emphasis is also laid in this edition to Cell Mechanics to which the last and longest of the 12 chapters of the book is devoted. In this chapter Dr. Darlington shows clearly how the laws of movement of chromosomes are explainable from the mechanical point of view. In many respects this is the most important chapter of the book.

The Glossary and Bibliography presented in the book adds much to its value as a ready reference not only to all research workers engaged in cytology and genetics, but such university teachers who wish to keep their teaching in pace with the rapid advance made by biological science to-day.

The book is excellently illustrated with 16 plates, 160 text-figures and 81 tables, which present the most recent findings in the field of modern cytology.

The Indian Zoological Memoirs—VI. *Palaemon.* By S. S. Patwardhan, D.Sc. (Lucknow Publishing House, Lucknow). 1936. Pp. xi + 100. Price Rs. 2.

The sixth volume in the series of Indian Zoological Memoirs deals with the Indian river prawn *Palæmon*. In the introduction some of the important characters of the class Crustacea are enumerated with special reference to the Decapoda. The systematic position of *Palæmon* is briefly indicated and a key (after Kemp) is included to distinguish the three genera of the sub-family to which this prawn belongs. The systematic part might have been dealt with perhaps in a little more detail and the species of *Palæmon*, which forms the basis of the memoir should have been definitely stated. From the foot-note on p. viii and from one or two other scattered references in the text one presumes that the species dealt with is *P. malcolmsonii* but it would have been useful if the author had definitely stated whether the account refers to this particular species or is, so to say, a composite picture of a member of species.

The external characters, the appendages, the integument, the endophragmal skeleton and the various systems of the body are all described in great detail and a short chapter on bionomics and distribution is also included. A useful chapter on directions for practical work ends the work. Reproduction and embryology have not been dealt with.

The illustrations, which are mostly original, are very well done. These are useful in explaining the different structures, but it would have helped the reader more if the explanatory reference letters had been mentioned in the text also.

Only a very few of the important references are given as foot-notes; it would have been an advantage perhaps if a short Bibliography had been included at the end.

The memoir is very well got up and is on the whole free from misprints. Both the author and the editor are to be congratulated on the production of this fine work, which will undoubtedly be of very great use both to the students and the teachers.

Dr. Bahl, the Editor of the series, deserves the thanks of all Indian zoologists for maintaining the high standard of these memoirs. His recent donation of Rs. 700 towards the cost of publication of the series, to which reference is made in the Editor's preface, is only another instance of the great interest that he takes in this work.

B. N. C.

A Practical Course in Agricultural Chemistry. By Frank Knowles and J. Elphin Watkin. (Macmillan & Co., Ltd.), 1937. Pp. ix + 188. Price 10*sh.*

This book achieves fairly well what the authors set before themselves to accomplish—a practical text-book of a practical course in agricultural chemistry. Well-known, standardised and accepted methods are fully and well described, in such a manner as to leave no doubt in the mind of the student. People working in different fields of agricultural chemistry may regret the omission of this or that method, but viewed as a whole and from the point of view of the student working up for an examination the choice of methods has been usefully selective. This book can be safely recommended for guidance for all students to whom the field of agricultural chemistry is new.

N. G. C.

Calcutta Geographical Review. Vol. I, No. 1. (Published by the Calcutta Geographical Society), September 1936. Annual Subscription Rs. 3–8–0.

It is well known that in Western countries, those in charge of the education of the young, have all along realised the great educative and cultural value of a proper study of Geography, and have therefore not only included this subject in the secondary schools, but have also provided for graduate and post-graduate courses in the university. In India, we have for long been suffering from antiquated and mistaken notions of the meaning and scope of this subject, with the result that Geography is to-day the most despised and the worst treated member in the family of subjects claiming a place in the curriculum of schools and colleges in India. It is, however, gratifying to find within recent years, that educationists all over India have begun to realise that they are making a great mistake in thus neglecting the study of Geography, and are striving to find for it an honoured place in their reorganised courses of studies. The neglect of Geography in the past has been largely responsible for the making of poor citizens, with a narrow and mean outlook on life. In

the words of Prof. Atwood of Clark University in his Presidential Address to the National Council of Geography Teachers, "There never was a time in the history of the world, when a study of the various people of the world, and the geographical condition influencing their lives, directing their plans as they seek for means of existence, should be taught so thoroughly as to-day. The responsibility is before us. I submit that there is no subject in the school curriculum that so naturally and so necessarily deals with the large world-wide problems of to-day as Geography. There is no subject in the school curriculum that can so appropriately deal with the actual living conditions in the different parts of the world of the present time." The general public in India have to be rapidly educated to appreciate the importance of the subject of Geography, and in this endeavour, the Madras Geographical Association gave the lead several years ago. We are glad to note that a similar society has recently been organised in Calcutta for the promotion and spread of geographical knowledge, and it is with sincere pleasure that we welcome the first number of their *Geographical Review*. The society has been fortunate in enlisting the sympathy and support of a number of distinguished and influential men in Bengal, and the Journal is conducted by a thoroughly competent Editorial Board, presided over by the well-known Indian geologist and geographer, Mr. D. N. Wadia of the Geological Survey of India. The first number of the Journal which is now before us contains several very interesting articles written by men with first-hand knowledge of the subjects they are dealing with. The place of honour is given to an article by Dr. A. M. Heron (Director, G. S. I.) on "The Everest Neighbourhood" in which he gives a lucid account of the main geological and geographical features of this neighbourhood, including a vivid pen picture of life in a typical Tibetan village. In their article on "Glimpses of Burma and the Shan Hinterland," Dr. M. R. Sahni and Mrs. Shyama Sahni have given us a wonderful account of this part of the country and its people—an account which is as fascinating as it is informing. In "The Story of a Stone", Mr. D. N. Wadia makes the 'stone' speak for itself, and it succeeds in giving us several fundamental lessons in Geology, all the while keeping us absorbed in its autobiography. After reading this, who can deny the fact that there are truly "sermons in stones?" Many of the articles in the Journal bring out in a striking manner the intimate and inseparable relationship between Geography and Geology; in fact, no geographical studies of the right kind are ever possible without a suitable geological background. We wish the Journal a long and prosperous career of ever increasing usefulness.

L. RAMA RAO.

Nature Study Reader for Fourth Year Pupils. By Phyllis S. Darling, M.R.S.T., F.R.S.G. (Oxford University Press), 1936. Pp. 62. Price As. 10.

This little book maintains the high standard established by the previous publications on the same subject for lower class pupils, and contains a graduated series of twenty-seven lessons. We congratulate the author on producing these excellent interesting little books on the important series of topics, calculated to train the eye and the hand, and to stimulate the spirit of curiosity. The book is written in simple English and should offer no difficulty either in teaching or learning.

The chapter on stars might offer some difficulty in understanding or identifying the different constallations, because the vernacular equivalents are not given. This chapter might have been rendered more interesting and useful if some reference to the appearance and the relative position of some of the bright planets, had been included. For instance, the conjunction of Venus, Jupiter and the Moon at certain months of the year is one of the most conspicuous phenomena of the Heavenly bodies, and the pupils ought to witness such conjunctions and note the time of the month in their diaries.

The topics of other chapters are carefully selected and adequately treated. Beautiful illustrations of the common tank and pond fish, sea shells and some fresh-water insect larvæ are included, and they certainly enhance the value of the book. We hope that this book will be widely used in all the schools and we doubt whether better books are in the field.

The Ice Age.

[*The Quaternary Ice Age*, by W. B. Wright. (Macmillan and Co., London), 1937. Pp. xxv + 465, with 23 Plates. Price 25*sh.* net.]

THERE are few questions connected with the geological history of our earth which has exercised the popular imagination more than the one regarding its very recent passage through a glacial period when large areas of the northern world, down to the latitude of 40° were frozen under a pall of ice-sheets and glaciers. That North Europe and America, just at the advent of Man in Europe, or contemporaneously with a few already established races in the more southern parts, were covered under vast ice-caps very much like the North and South Polar regions of to-day is one of the most satisfactorily proved events of geological history, even if science has not yet succeeded in finding a generally accepted cause, or causes, for this unique phenomenon. Indeed no section of geological history possesses a more voluminous literature or inspires a greater number of amateur investigators, and yet the mystery of the subject has deepened with the growing literature. It can perhaps be truly said that we are not nearer solution to the question of the causes of the Ice Age than when Croll propounded his famous astronomical theory in 1885, ascribing the glaciation of North Europe and America to a time when, the eccentricity of the earth's orbit being considerably greater than at the present day, the northern summers occurred in perihelion.

In the attractively got-up volume before us, the revised second edition of his book originally published in 1934, Mr. W. B. Wright of the Geological Survey of Great Britain has presented the subject in a lucid manner both for the student and the layman. He gives a clear account of the existing state of knowledge regarding the Ice Age of Europe and America, more especially in regard to its relations to man, the Quaternary mammals, and the displacements of sea-level consequent on the withdrawal of large volumes of sea-water required for the formation of ice-sheets of continental magnitude, and their restoration to the sea on the termination of the Ice Age.

The question of the interglacial ages—the four or five interludes of comparatively mild climates intervening the cycles of arctic intensity, which was rather inadequately dealt with in the last edition of the book, in conformity with the trend of thought 20 years ago, is now more exhaustively treated both for Europe in general and for the Alps.

The author's main original contribution to the subject, the so-called isokinetic theory, to account for the oscillating sea-levels during the Quaternary, as marked by the fluctuating strand-lines of the northern coasts, is given special treatment in two chapters. The isokinetic theory is a modification of the theory of Isostasy, which in essence implies that there is a certain amount of hydrostatic balance between the different segments of the earth's crust so that if an extra load is imposed on any portion of the surface it must sink under it, while the adjacent unloaded parts must rise until equilibrium is established.

The formation of an ice-sheet on land several thousand miles in extent and 3000 to 4000 feet thick, such as the one which covered Scandinavia during the Pleistocene Ice Age, must, if isostasy is perfect, have depressed the crust over that area under the extra load to the extent of as much as one-third of the thickness of the superincumbent ice. The withdrawal of so much water from the sea to form the enormous ice-caps of Fennoscandia and North America at the same time, would, according to the original estimates of Penck, have caused a world-wide lowering of the ocean level, during the height of the Ice Age, to the extent of about 300 feet. At the height of the glacial epoch, therefore, the strand-lines of the world were considerably lower than now and as the ice gradually retreated, isostatic recovery took place and not only the unloaded lands rose, but the melting ice caused the sea-level to rise once again submerging considerable areas of the land-surface and giving rise to new post-glacial shore-lines and terraces.

How far this simple hypothesis explains the complex facts of the relative displacements of land and sea and the confused story of elevated and depressed shore-lines, beaches and terraces in different parts of the world during the last geological epoch,

it is not yet possible to estimate. The researches of Swedish and Norwegian glaciologists do not lead one to conclude that some kind of isostatic balance affords the best explanation of the noteworthy relations of glacial and post-glacial changes of sea-level as reflected by the struggle between sinking land and falling sea-level at one time and rising land and rising sea at another. The theory of isostasy had its birth in India, but the brilliant work on gravity estimation carried out by the Geodetic Survey of India during the last decade and the data collected in support of the crustal warp theory by Col. Glennie are so much at variance with the hypothesis of isostasy as to lead one to doubt whether the postulates of isostasy are fundamentally correct.

The chapter on Loess, Quaternary mammals and post-Tertiary Man contain much condensed information and is of great interest; the author summarises the facts of the correlation of fossil mammalian fauna and the successive human cultures with the zonal sub-divisions of Quaternary stratigraphy of Europe in a manner that is bound to interest both the man of science and the lay reader. One serious shortcoming of the book, however, is lack of any reference to the glaciation of North Asia, the whole area of which, including Siberia, being not mentioned. While this may be due largely to the fact that no such authoritative investigation on the subject has been carried out in this region as in Europe, a brief statement of existing information on this subject and some tentative hypothesis accounting for the absence of continental ice in North Asia would have added to the interest of the book.

The volume is well illustrated with diagrams, sections, photographs and maps. A copious Bibliography accompanies each chapter and the Index covers eleven pages.

D. N. WADIA.

Biology of the Desert Locust *Schistocerca gregaria.*

THE record of Locust control work in the past in India narrates a story of expensive and troublesome operations carried out in various tracts visited by the pest and almost total indifference to the problem after it had disappeared. No systematic or concerted action regarding control of any pest is possible unless accurate data about the biology, life-cycle, habits and habitats of the pest are available. On the occasion of the last serious visitation by Locust in 1926–30 very little information about the biology of this pest in India was available. Towards the close of this visitation the Imperial Council of Agricultural Research initiated and financed an elaborate research scheme under which the pest was to be thoroughly studied both in the laboratory and the field. Mr. M. Afzal Husain was appointed Locust Research Entomologist at Lyallpur and held this appointment for about three years. The headquarters of the field staff which was under Mr. Ramachandra Rao, was first fixed at Quetta and then at Karachi with a field laboratory at Pasni on the Mekran Coast in South Baluchistan. The work done at Lyallpur on the biology and physiology of Locust is being published in a series of articles in the *Indian Journal of Agricultural Science* of which seven papers have appeared up to now (Vols. III & VI) and are the subject of this review.

Although the Desert Locust has been a periodic visitor of the extensive plains of this country it does not seem to have been able to establish itself permanently in India, except some parts of Sind, Rajputana and South Baluchistan. It is interesting to ascertain the cause of this curious behaviour. The ecological studies carried out indicate that *Schistocerca gregaria* is a tropical insect with the threshold of development at about 18°C. (about 64°F.). This means that apart from food and humidity factors, wherever the winters are severe and the temperature remains below the threshold of development of the species for a considerable period, the pest will be subjected to high mortality.

The exact number of broods of the Locust in a year was also under dispute and several workers were of the opinion that *Schistocerca gregaria* undergoes a compulsory resting period (diapause) in the adult stage, whereby the number of broods is limited to one or two in a year. It has now been shown that the life-processes of this species, like those of other insects, are intimately connected with and controlled by the environmental temperature, that it can breed within the temperature range of 25°–40°C., and that there

is no diapause in the true sense in any stage of this insect. Therefore though under natural conditions in the Punjab, the locust has only two broods in a year, under temperature conditions ranging from 37°C.–40°C. as many as 6–8 generations in a year are possible. These conclusions are of great importance and reveal the potentialities of this pest under suitable environment.

The Locust is known to have two phases: solitary and gregarious. In the solitary phase the colour of the hoppers is greenish whereas in the gregarious or swarming phase the body has a black pattern. The causes underlying the change of solitary phase into the swarming phase and *vice versa* are undoubtedly of great importance both from economic and academic points of view. The work under review indicates that it is possible to convert a *solitaria* hopper into a *gregaria* one by crowding it with other hoppers and make a *gregaria* hopper lose its black markings by breeding it isolated. Moreover it has been shown that an isolated hopper of *solitaria* nature when forced to move about for a considerable time each day and thus given exercise artificially developed the black pattern of the *gregaria* phase irrespective of crowding with which alone it was hitherto supposed to be intimately associated. Likewise an isolated *solitaria* hopper when bred in an atmosphere containing excessive carbon dioxide developed the black pattern, associated with the *gregaria* phase. It would appear from these experiments that the production of the black pigment is connected with the rate of metabolism as well as the respiratory function of the organism. Some experimental evidence has been furnished to show that hoppers of true gregarious phase exhibit intensities of black pigmentations in inverse proportion to the temperature of the environment. These observations, admittedly incomplete, have important significance on the phase theory according to which the two phases are based on the colour and morphological differences. It however, yet remains to be seen whether the morphological differences can be brought about by environmental changes or whether they are a result of association alone.

The fact that most Locust adults change their colour to yellow, at the time of sexual maturation, had given rise to impression that the extensive physiological changes that occur during the development of the genital products result in the formation of the yellow pigment. This has proved to be wrong. Males as well as females whose sex glands were removed in their last hopper stage and which on dissection at death were found not to have regenerated these glands developed the yellow colour as rapidly as the normal adults. Moreover, adults bred at comparatively low temperature matured and oviposited without ever yellowing.

It is hoped that economic entomologists will, in due course, be able to exploit the results described above to the advantage of farmers.

HEM SINGH PRUTHI.

Agricultural Research in India.

[*Scientific Reports of the Imperial Agricultural Institute, New Delhi, including the Report of the Sugarcane Expert, Coimbatore, for the year ending June 1936.*]

THE report of the Imperial Agricultural Institute, New Delhi, is the record of another year's work under the difficult conditions caused by the last disastrous earthquake in Bihar and by the preoccupation of the staff in connection with the shifting of the Institute to Delhi. Much of the research and experimental work had to be suspended and the actual work has related only to the completion of those already on hand. Though therefore much restricted in volume, the work and results reported continue to be of much scientific and practical interest. In the Chemical Section the effect of sunlight and ultra-violet light on nitrification in soils, both acid and alkaline in reaction, was further studied and the results showed no evidence of nitrification at all. We may perhaps take it that this definitely disproves the claims made to the contrary by Prof. Dhar. The study of acid soils and their amelioration was continued and as a result the use of a mixture of calcium and sodium carbonate is advised in preference to either of them applied singly, the former incidentally being

a less expensive method in practice. Knowing the deleterious action of sodium carbonates on the physical condition of soils one is generally chary of resorting to the use of such salts, and we should, for this reason, like to see further work on the subject. Large scale experiments on green manuring with sann hemp have confirmed previous observations and show that the crop could be grown for a longer period and made use of for a double purpose, the tops for green-manuring and the stems for fibre-making and that this method is quite as good as if the whole plants were incorporated in the soil for manure.

In the section on Crops, wheat breeding occupies the pride of place the aim being chiefly to evolve types resistant to cereal rusts; a separate section was created for this work in the year and some promising crosses have already been produced and selected for further work on breeding. The older varieties of Pusa fame have continued to be popular and large quantities of seed have been supplied, in fact the demand is said to have been more than could be met by the Institute. Attention is drawn to the striking differences in the malting quality of one and the same type of barley when grown in different tracts, which one would think was only in accordance with the general belief in the influence of soil composition and manuring on 'quality' in barley. Work on potato breeding was commenced in the year and a number of Indian and Foreign varieties including varieties from Central and South America were studied; likewise a large number of seedlings were successfully raised and a good many crosses also effected. We may look forward to important results in the evolving of high-yielding and disease-resistant types, a desideratum which has seriously kept back the popularisation of this valuable food crop.

The Sugarcane Station, Coimbatore, maintained its high level of research both of practical value and scientific interest. The station was able to release for trial during the year a few types of canes combining earliness with good tonnage. The sorghum sugarcane hybrids have been, it is reported, found disappointing as regards earliness which was the characteristic about which high hopes were entertained. The problem is however to be attacked on a wider basis, we are told. The breeding of thick canes has also been attended with much success; the new types Co 419 and Co 421 have done very well, and on the Padagaon Station Co 419 gave a higher yield than the famous P.O.J. 2878. A very noteworthy result has been the production of bud sports by the simple process of bruising and damaging the eyebuds of the seed setts; we wonder if the method will succeed with a large percentage of buds and again likewise with other varieties also, which has been achieved in the variety Co 213. Cytogenetic studies which form a new feature of the work in the station established the genuineness of the sugarcane sorghum crosses about which apparently there was doubt. The development of a suitable technique in this work occupied particular attention in the year.

In the section on Plant Diseases and Pests we may specially draw attention to the study of the bionomics of the parasites of sugarcane pyrilla, as the result of which the periodical removal of the leaf-sheaths of affected cane is suggested as a measure of some relief. The work on the mosaic of sugarcane in the Mycological Section is of absorbing interest and will well repay study. This baffling disease is being examined from various angles including serological studies. The reactions and behaviour of the virus under a number of conditions are reported and the interesting observation made that the infectivity appears to be associated with chlorophyll, as filtrates remain active only as long as the green colour persists. We are led to hope that beforelong much light will be thrown on the different aspects of this difficult problem.

It is gratifying to read that the famous Pusa herd of dairy cattle has not only maintained its high standard but has even excelled past performance, the milk yield average having increased from 19·1 lbs. in the last year to 21·2 lbs. in the year under report. The herd is now being moved into its original home and it will be interesting to watch its reaction to this, its home coming after such a long period.

The chief event of the year is the transfer of the Institute to its new home in Delhi. This marks a new epoch in its history and we note that all the different sections commence work in their new sphere with greatly added facilities for research. On the threshold of this new era we offer to this great and beneficent institution our best wishes for a long career of practical usefulness and scientific distinction.

A. K. Y.

The Cape Crawfish.*

THE Cape crawfish, *Jasus lalandii* (Milne-Edwards), forms the basis of a very extensive industry in the Union of South Africa and the publication of the report by Cecil von Bonde entitled "The Reproduction, Embryology and Metamorphosis of the Cape Crawfish (*Jasus lalandii*) (Milne-Edwards) Ortmann" is, therefore, of special importance for the scientific exploitation of this industry. The present report is more or less a continuation of the work that the author did in collaboration with J. M. Marchand on the natural history and utilisation of the Cape crawfish a couple of years ago. In the present pamphlet the life-history of the crawfish from the fertilisation of the egg to practically the adult stage is described. The importance of the knowledge of reproduction and development of the animal is emphasised in view of the possibility of its application for artificial breeding.

After enumerating the secondary sexual characters by which the sexes may be recognised easily, the author gives a detailed description of the female and male reproductive organs. The period of maturity is estimated at $2\frac{1}{2}$ years after birth in the case of females and 5 years in males. The frequency of spawning has not been established definitely, but it appears that females after the first sexual cycle lay their eggs at definite seasons, possibly biennially. Two formulæ for estimating the number of eggs produced are given and the number is computed between 3,000 and 20,000 according to size. The process of mating in crawfish is described for the first time and the preparations that the female makes for egg-laying and the actual process of laying the eggs are dealt with. No very accurate observations on fertilisation have been possible, but it is believed to be undoubtedly internal. The eggs are laid singly and are more or less like bunches of grapes. It takes the female about three to four hours to lay all her eggs.

The second part of the report deals with embryology. The maturation of the ovum is briefly referred to, and segmentation is said to start about 10 hours after the eggs are laid. Segmentation is described in great detail and the time taken for each of the different stages is mentioned. The gastrula stage takes about 10 days to appear and the stage corresponding to the nauplius develops inside the egg in about 35 days after fertilisation. The appearance of a median eye about 50 days after fertilization and its persistence till after hatching is of special interest. About 95 days after fertilization the larva hatches out.

The third part deals with metamorphosis and subsequent growth. The first free swimming stage, the "prenaupliosoma," was observed about 8 hours before the "naupliosoma", which had so far been considered as the first free swimming stage. Both these stages are described in detail. The naupliosoma by a direct metamorphosis and ecdysis gives rise to "phyllosoma", about 8 days after hatching. This passes through different stages till it is about 35 mm. long. By a striking metamorphosis this now changes into a "puerulus" of 22 mm., which in all essentials is like a small adult. This grows in size and after passing through some more stages assumes the characters of a fully grown crawfish. The latter part of the life-history has still to be worked out in detail. The rate of growth is slow and a very young specimen kept under observation grew only 0·25 inch in nearly two years, but possibly the rate is somewhat accelerated as the age advances.

The last chapter briefly gives the technique employed in studying the eggs and in preparing photomicrographs. The information contained in this section is very useful.

The report concludes with a short bibliography, which includes practically all the important references on the subject.

The paper is illustrated with 12 plates, a large number of which are direct photomicrographs. The different parts of the animal and the life-history, including the various developmental stages, are all very clearly illustrated.

The report under review is based on a thorough and painstaking piece of research carried out both in the laboratory and under natural conditions. It should prove of great use to the people interested in the crawfish and allied industries as also to scientific workers in general.

B. N. C.

* "The Reproduction, Embryology and Metamorphosis of the Cape Crawfish, *Jasus lalandii* (Milne-Edwards) Ortmann." *Investigational Report No. 6 of the Department of Commerce and Industries*, Fisheries and Marine Biological Survey Division of the Union of South Africa.

CENTENARIES

S. R. Ranganathan, M.A., L.T., F.L.A.
(*University Librarian, Madras*)

Hoff, Karl Earnst Adolph Von (1771–1837)

K. E. A. VON HOFF, German diplomat and amateur geologist, was born at Gotha on November 1, 1771. In his seventeenth year he entered the University of Jena and proceeded after two years to Gottingen. In 1791, he became Secretary of Legation under his own Government of Gotha. He was in active diplomatic service right through the Napoleanic period and the years that immediately followed Napolean's fall.

Urge for Scientific Work

Yet amid all the excitement of the times, Von Hoff was pursuing his study of geology under the urge he received for scientific pursuit from the inspiring personality and scientific career of Dr. Johann Friedrich Blumenbach, justly known as the founder of Anthropology. He explored the forests of his native district of Thuringia in a number of geological excursions. He was thoroughly familiar with the extant geological literature. He popularised Hutton's geological theory in the Continent and took a leading part in freeing geologists from their then popular catastrophic school.

His Writings

His urge for dessiminating geological knowledge was so intense that he founded in 1801 his own periodical for the purpose, under the title *Magazin fur die gesammte Mineralogie, Geognosie, etc.* His first three contributions appeared as the first three articles in that *Magazin*. As many as 46 papers of his were published during the next 35 years, the last paper being the one entitled *Weben des barometrische Nivellement Von Thuringen*, which appeared in 1835 in volume 12 of *Berghens annalen*.

His Famous Work

His most famous work is the *Geschichte der durch Uberlieferung nachgewiesenen naturlichen Veranderungen der Erdoberflache* 3V. 1822–34. This is said to be a work of immense originality and free from the prejudices of his day. Two more supplemental volumes came out posthumously in 1840–41, with the special title *Chronik der Erdbeben und Vulhanansbruche*. These two volumes constitute a valuable and praiseworthy piece of work on earthquakes. It begins with the year 1606 B.C. and colses with the year 1805. For the next fifteen years there are no entries. Then follow the annual lists till 1832. Von Hoff was the first to issue annual lists of earthquakes and the first also to compile a general catalogue of earthquakes for the whole world. His first ten annual lists were published in the *Annalen der physik und chemie*. They relate to the years 1821–1830. Those for the years 1831 and 1832 were published only in his *Chronik*. Taking all the twelve years together, the number of earthquakes per annum ranges from 17 to 95. The total number of earthquakes chronicled by Von Hoff is 2,225.

Von Hoff died at his native place, Gotha, on May 24, 1837.

Hicks, Henry (1837–1899)

HENRY HICKS, Doctor by profession and Stratigraphist by fame, was born on 26 May 1837, at St. David's, Pembrokeshire. His father was a surgeon. His early education was at the local Cathedral Chapter School. He studied medicine at Guy's Hospital and became a member of the Royal College of Surgeons in 1862. He then returned to practice at his native town. In 1871, he went to practice at Hendon in Middlesex. In 1878 he specialised in mental diseases and got the M.D. degree of St. Andrews. This helped him to become the head of a lunatic asylum for ladies located at Hendon Grove. This new appointment, which he kept till his death, freed him from the interruptions of ordinary practice.

Diversion to Stratigraphy

The diversion to stratigraphy, to which he owes his prominent position in the world of science, was due to the influence and help of his friend, John William Salter, Palæontologist to the Geological Survey. In 1863, the first year of his practice at St. David's, Hicks' attention was attracted to geology by Salter's discovery, for the first time in Great

Britain, of the remains of the large Trilobite Paradoxides in the "Lower Lingula Flags" of St. David's. Dr. Hicks' curiosity was roused. He commenced to search for fossils among the old rocks around him. As he himself has said, the enthusiasm with which every new find was welcomed by Salter, "to whom they were first sent, was in itself a sufficient stimulus for any exertions required." Salter secured for him a grant-in-aid from the British Association. In the 1864 meeting at Berth, Salter reported that the energetic work of Hicks "has already brought to light more than thirty species of fossils". These discoveries "made a large addition to the Primordial fauna".

His Contributions

Hicks pursued his work with unflagging devotion. He pushed his enquiries into the very oldest pre-cambrian rocks, both in Wales and Scotland. He also gave attention to the strata immediately preceding the present order of things and pursued with equal ardour, the evidences of glaciation in South Wales and Middlesex, the records of old bone-caves and the remains of mammoth in the Thames Valley. No man had a keener eye for fossils. To his eyes, rocks which had for long beeen deemed unfossiliferous disclosed evidences of past life. In 1890, Hicks turned his attention to North Devon and he was the first to discover a rich fauna in the Morte slates of that region, which were considered to be entirely unfossiliferous.

His Writings

He published 82 papers in his life-time. The first paper entitled *On the lower lingula flags of St. Davids* appeared in V. 5 of the *Proceedings* of the Geological Society in 1864. The last formal paper was on *The age of the Morte Slate fossils.* It appeared in V. 4 of the *Geological magazine* in 1897.

His Honours

Hicks was greatly respected for his enthusiasm for his hobby. He himself used to say that in his busy professional life, he found geology a "means of recreation and of much intellectual enjoyment". He took a prominent part in scientific organisations. He was President of the Geologists' Association from 1883 to 1885 and of the Geological Society from 1896 to 1898. The Geological Society awarded him the Bigsby Medal in 1883. The Royal Society of London elected him one of its Fellows in 1885. He was a Honorary Member of several foreign learned bodies. He was often involved in controversy, but he enjoyed an intellectual battle, the stress of which never ruffled the course of friendship for more than a moment.

An attack of rheumatic gout affected his heart and proved fatal on November 18, 1899.

ASTRONOMICAL NOTES.

1. **Total Solar Eclipse.**—There will be a total eclipse of the sun on June 8th, 1937, but the phenomenon will be completely invisible in India. The path of totality commences about 1,500 miles to the north-east of Australia and crossing the Pacific Ocean, ends at sunset in Peru on the west coast of South America. The duration of totality will be $7^m.\ 4^s.$ in the middle of the path. It is announced that an American expedition is proceeding to one of the islands in the South Pacific for observing the eclipse.

2. **Planets during June 1937.**—Venus will be a morning star throughout the month and will attain greatest elongation from the Sun (46° W.) on June 27. Mars is favourably situated for observation during the greater part of the night; its angular diameter will be 18″ and the stellar magnitude −1·5 nearly equalling Sirius in brightness. The planet will be stationary on June 28. Jupiter and Satura will also be interesting objects and can be well observed late in the night; the former rises at about 9 p.m. in the middle of the month and the latter about midnight reaching the meridian early in the morning.

3. **The Milky Way.**—Many of the rich fields of the galaxy will be in a favourable position for observation, about midnight in the month of June. The star clouds in

Sagittarius and the dark patches and lanes in the region of Ophiuchus form interesting objects for study. The globular cluster Messier 13 in the constellation Hercules is just visible to naked eye and can be observed with advantage even with instruments of moderate power.

4. Comet Notes.—Information has been received of the discovery on February 27 of a comet by A. Wilk at Cracow (Poland) and independently on the same day by L. C. Peltier in America. The comet was at the time near maximum brightness and has since been fading rapidly. Comet 1937 *b* (Whipple) has been well observed and its brightness is slowly increasing; it should be visible by instruments of small aperture. On the 9th May, it was a fairly easy object of magnitude between 8 and 9 in the constellation Ursa Major.

5. A White Dwarf Star.—In Pulkowa Observatory *Circular* No. 19 A. N. Deutsch draws attention to the peculiarities of the Star B.D. + 59°·2723. Its position is given by R.A. 23^h 22.0^m, Declination 60° 50′ N. and its spectral type is F2. It has a proper motion of about half a second of arc annually, and a parallax of 0·019 is given in Schlesinger's new *Catalogue*. The absolute magnitude computed from these values is + 7, the luminosity thus being about 1/7 that of the sun.

T. P. B.

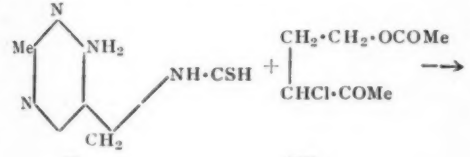
Indian Science Abstracts.

THE National Institute of Sciences of India, Calcutta, resolved to issue a publication under the title "INDIAN SCIENCE ABSTRACTS" with the sub-title "*being an annotated bibliography of Science in India*". The first part of the publication appeared in July 1936, and the general editor realising the impossibility of making such a publication complete without the active co-operation of all scientific workers in the country, requested them to look through it and see whether all their scientific publications issued during the year 1935 had been included in it (see *Curr. Sci.*, 1936, **5**, 16). The second part which has just been issued is complimentary to the earlier part, and the two together constitute a complete record of all the publications issued during 1935 in India, as also of papers published abroad on work done in India or based on Indian material.

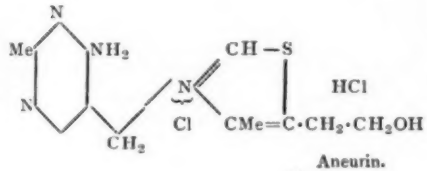
The matter is arranged under nine sections:—I. General, II. Mathematics (including Mathematics, Astronomy and Geodesy), III. Physics (including Physics and Meteorology), IV. Chemistry (including Pure and Applied Chemistry), VI. Geology (including Geology, Palæontology, Mineralogy and Geography), VII. Botany (including Pure and Applied Botany, Forestry and Agronomy), VIII. Zoology (including Pure and Applied Zoology, Veterinary Zoology and Anthropology including Technology), IX. Physiology (including Animal Physiology, Veterinary Pathology and Bacteriology and Medical subjects). The publication represents an ably edited document of nearly 200 pages. All those interested in the scientific progress of the country will be greatly indebted to the general editor for his painstaking efforts in bringing out a volume which will portray to the world of international science the contributions made by the scientific workers in India.

RESEARCH ITEMS.

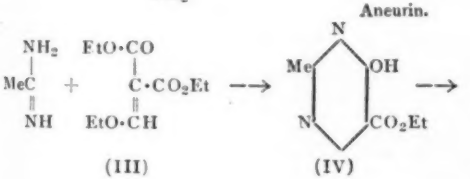
Synthesis of Aneurin (Vitamin B_1).—Todd and Bergel have recently described (*J. C. S.*, 1937, 364) a synthesis of aneurin; details of previous reported syntheses (*cf.* Williams and Cline, *J. Amer. Chem. Soc.*, 1936, **58**, 1504; Grewe, *Z. physiol. Chem.*, 1936, **242**, 89) have not yet been published. The new synthesis depends on the condensation of 4-amino-5-thioformamidomethyl-2-methylpyrimidine (I) with methyl α-chloro-λ-acetoxypropyl ketone (II). Various alternative routes to (I) are described of which the most reliable is the following. Ethyl ethoxymethylene-malonate (III) condensed readily with acetamidine in presence of sodium ethoxide to give ethyl 4-hydroxy-2-methylpyrimidine-5-carboxylate (IV) which after successive chlorination with phosphoryl chloride and heating with alcoholic ammonia under pressure yielded ethyl 4-amino-2-methylpyrimidine-5-carboxylate (V). After conversion of (V) into the corresponding amide with concentrated aqueous ammonia, the product was dehydrated to give the nitrile 4-amino-5-cyano-2-methylpyrimidine (VI) which on catalytic hydrogenation yielded 4-amino-5-aminomethyl-2-methylpyrimidine (VII) isolated as the hydrochloride. From (VII), (I) was readily obtained on treatment with aqueous potassium dithioformate. (I) and (II) gave aneurin on heating together at 115–120° for a few minutes.



(I) (II)



Aneurin.



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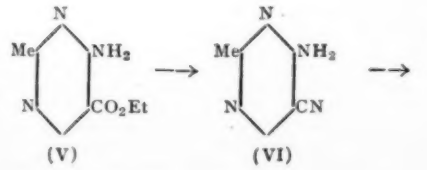

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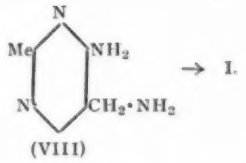

(VIII)

. S. W.

The Search for Element 87.—The first search for element 87 was made by K. T. Bainbridge in 1929. Studying the likely sources by the positive ray method, he failed to detect in them the presence of the element. F. Allison and E. J. Murphy (1930) applying their magneto-optic method reported the discovery of the element in lepidolite and pollucite. Their method however is open to question. In 1931, J. Papish and E. Wainer announced their finding of several of the X-ray lines of element 87, using a concentrate derived from samarskite. Hulubei (1936) examined a pollucite extract by means of the X-ray spectrograph and obtained two lines which he considered as the $L\alpha_{1,2}$ doublet of element 87.

F. R. Hirsh Jr. (*Phys. Rev.*, 1937, **51**, 584) has repeated the experiments of Papish and Wainer and has been able to reproduce the lines. He has shown, however, that the lines are not due to element 87 but are caused by the photographic registration of the surface defects of the calcite crystal employed. (It is of interest to note that the calcite crystal used by Hirsh is the same as was used by Papish and Wainer). On oscillating the crystal to eliminate the defect, the lines disappear completely. Hirsh has further examined the results of Hulubei and has shown that it is more plausible to interpret the lines obtained by the latter as the $L\beta_3$ and $L\beta_1$ lines of mercury (with which his X-ray tube target was contaminated). In view of these considerations Hirsh concludes that the search for element 87 is still open.

K. S. G. D.

Atomic Weight of Oxygen.—Smith and Matheson have reported (*J. Res. National Bureau of Standards*, 1936, **17**, 625–628) the results of their work on the difference in atomic weights of oxygen from air and from water. Accurate determinations of the density of water were made by using the twin quartz pycnometer, employing specimens of water prepared by the union of atmospheric oxygen and of oxygen derived from water respectively, with specimens of hydrogen which had been brought to uniform isotopic composition by the usual process employing ammonia. Samples of water so prepared differed only in respect of the isotopic composition of the oxygen present in them. The observed mean difference in density was 8·6 p.p.m., the water derived from atmospheric oxygen being the heavier. This difference in density corresponds to a

difference in atomic weight of 0·00014 between atmospheric oxygen and oxygen present in water.

K. R. K.

Silica in Portland Cement.—A rapid method for the determination of silica in Portland Cement has been described (Edwin E. Maczkowske, *J. Res. National Bureau of Standards*, 1936, **16**, 549–553). The method consists in mixing the sample of cement with roughly an equal quantity of ammonium chloride, digesting the mixture with hydrochloric acid for about half an hour and filtering off the silica as usual. This shortened procedure avoids the tedious double evaporation customary in silica determinations. The results obtained by this procedure have been compared with those obtained by the standard method and have been found to be reliable.

K. R. K.

The French Sugar Scale.—The French Sacharimeter Scale yields values for sucrose content which differ by about 0·1 per cent. from the values obtained with the International Scale (Frederick Bates and Francis P. Phelps, *J. Res. National Bureau of Standards*, 1936, **17**, 347–353). This is due to the incorrectness of the normal weight of sugar prescribed by the French Technologists. This paper points out that correct calculation of the data obtained by French investigators leads to a figure for normal weight which is identical with the International Standard, namely, 16·269 g. It is, therefore, recommended that the French Sugar Scale should be rectified by discarding the present normal weight of 16·29 g. and employing instead the International value, *viz.*, 16·269 g.

K. R. K.

Biological Digestion of Garbage with Sewage Sludge.—The underground sewerage system of removal of household wastes developed so far and the methods of purification adopted thereto have concerned themselves mainly with fluid wastes. Quite recently, however, attempts have been made, principally in America, to grind up the solid wastes, *e.g.*, waste-food (garbage) by electric motors and to convey them through the sink and plumbing into the sewers. This improvement, if adopted on the large scale, would ensure a more complete removal of waste material and at the same time serve to enrich the sewage with substances of high manurial value. The slow progress, however, which such an extension of the sewage method to the disposal of garbage has made so far, would draw attention to certain difficulties that lie in the way of its adoption, from the engineering as well as chemical points of view, *e.g.*, questions involving the capacity and ability of plumbing systems and sewers to convey ground garbage suspended in water, the nature of the increased load placed upon sewage treatment plants, the factors controlling the digestion of garbage with sewage, the optimum dosage of garbage which could be successfully manipulated, etc.

In an interesting pamphlet issued by the University of Illinois (*Bulletin* No. 24, Nov. 20, 1936), Dr. Babbitt and co-workers have subjected the chemical factors underlying the biological digestion of garbage with sewage, to a critical examination, conducting their experiments on a semi large scale. They find that garbage could be satisfactorily digested with sewage sludge, provided that it is finely ground and intimately mixed with the sludge and the percentage of sewage solids is kept above 20% (preferably about 40%) of the total volatile solids. The digestion could be carried out in Imhoff tanks, provided the rate of feeding did not exceed 1¼ tons of wet garbage per million gallons of sewage. Temperature controlled digestors could be operated successfully at a loading equipment of about 3 c.ft. of digester capacity *per capita*, based on a retention period of 30 days. The rate of gas production was markedly increased by the addition of lime (but not of caustic soda or soda ash), the peak being reached at 3 c.ft. of gas per day per c.ft. of tank capacity.

C. N. A.

Disperse Systems in Gases: Dust, Smoke and Fog.

THE study of disperse systems in gases is of great interest from the theoretical and technical standpoints and has received considerable attention from chemists and physicists. The discussion organised by the Faraday Society in April 1936 has considerably helped workers in this field by placing before them the present position of the several aspects of the subject.

General Properties of Aerosols.

In the introductory paper Whytlaw-Gray (p. 1042)* has briefly dealt with the general properties of disperse systems in gases, pointing out the scope of the subject under discussion.

The Formation of Aerosols.

The work of Stumpf and Jander (p. 1048) dealing with several methods of preparing finely divided and approximately unidisperse smokes in reproducible ways is of special importance for the systematic investigation of the dispersoids. Cawood and Whytlaw-Gray (p. 1059) have studied the effect of pressure on the photochemical production of ferric oxide aerosols. Their experimental results lead to the conclusion that the condensation nuclei are larger at lower pressures than when pressures are high, though as Goodeve (p. 1066) has pointed out from theoretical considerations that at all pressures, the

primary particle should be the ferric oxide molecule itself. Regarding the formation of mineral dusts met with in industry, the work of Green (p. 1091) is of interest; he has examined such dusts with regard to their size distribution. It is shown that most of the particles are $0{\cdot}2\,\mu$ to $2\,\mu$ in diameter. He has suggested that dusts are formed by the release of fine particles from the freshly formed surface and is closely connected with secondary structure in crystals. Philip (p. 1182) has considered the mechanism of formation of the aerosol that obtains when air charged with hydrochloric acid gas is passed through a solution of sodium hydroxide containing traces of ammonium hydroxide.

Stability and Coagulation of Aerosols.

Whytlaw-Gray has pointed out in the introductory paper that there is no evidence to show that stabilisation of aerosols can be brought about by protective colloids; R. S. Bradley's (p. 1088) theoretical considerations support this view. Any influence of the foreign substance on the formation of a fog should be interpreted on the basis of the effect that may be produced by the added substance on the size and form of the primary crystals (Fuchs, p. 1055). Fuchs has pointed out that stabilisation of a unipolarly charged cloud cannot be obtained by charging the walls of the containing vessel. If all the walls are charged to the same potential there will be no field inside. If however the potential varies along the walls of the vessel, the cloud moves across and settles at some portions of the walls. Smoluchowski's theory for rapid coagulation should therefore be applicable for aerosols. Harper's paper (p. 1139) on the theory of coagulation and the discussion thereon have definitely shown that there is no doubt regarding the correctness of the coagulation coefficient as calculated on the basis of Smoluchowski's theory. The disagreement with experiment observed by Cawood and Whytlaw-Gray (p. 1059) at lower pressures is ascribed to the heterogeneity of smoke and the departure of the shape of the particles from sphericity. The unusual stability of sulphuric acid mist obtained when sulphur trioxide reacts with water is shown by Dooli and Goodeve to be due to the formation of sulphuric acid droplets and not S_2O_6 as assumed by Sackur. Sulphur trioxide readily combines with water vapour and the droplets thus formed are big and exhibit but feeble Brownian movement. Collision with the liquid is therefore inappreciable and the droplets are quite stable. Remi shows that the absorption of sulphuric acid mist is mainly due to the turbulence of the air carrying the mist.

The course of coagulation under the action of sonic and ultrasonic waves has been followed up by photo-micrographic and kinematographic methods by Brandt and Hiedemann (p. 1101). There are two principal phases of the process as revealed by photo-micrographs taken at short intervals after the sonic waves are set up. In the first, the particles oscillate under the influence of the waves, take part in general circulation between node and antinode, and increase in size in the sound field by collision. In the second phase, the particles are so much enlarged that they no longer oscillate, but describe irregular tracks. The rate of growth of particles is studied by sedimentation velocity and nephelometric methods and is found to increase with sound intensity and time. Flowing aerosols of ammonium chloride and tobacco smoke were found to be effectively coagulated and precipitated by an air-jet generator of sound waves. Experiments with ultrasonic waves, however, are found to give different results. All particles do not oscillate and under certain conditions the particles rotate round one another without colliding and thus there is no coagulation. The theoretical aspect of coagulation under the influence of supersonic waves has been studied by Andrade (p. 1111) with certain simplifying assumptions. Andrade's theoretical considerations have been experimentally supported by Parker (p. 1115), who has worked with magnesium oxide smoke at a frequency of 220 k.c. a second. Grant has pointed out (p. 1120) the possibility of large-scale application of supersonics as a preliminary to electrical precipitation for removing smoke and dust particles from gases.

Particulate Volume in Aerosols.

Whytlaw-Gray, Cawood and Patterson (p. 1055) have described a sedimentation method for counting the number of particles present per unit volume in a smoke. Hill (p. 1125) has investigated the use of a photoelectric density meter to measure the optical density of smoke stains obtained by drawing a known volume of aerosols through a restricted area of filter paper. The concentration of smoke has been estimated to an accuracy of five per cent. The method has been employed in the measurement of atmospheric pollution.

Mass and Size of Particles in Aerosols.

Patterson and Cawood (p. 1084) have described the photometric and the graticule methods for determining the size distribution in smokes. These methods are applicable to a smoke having particles larger than $0{\cdot}1\,\mu$ in diameter. The mass and size of atmosphere nuclei have been determined by Nolan and Guerrini (p. 1175) by measuring the sedimentation velocity and the diffusion coefficient.

Rate of Charging of Particles by Ionic Current.

Fuchs, Petrjanoff and Rotzeig (p. 1131) have described a method for the determination of the rate of charging of floating particles by an ionic current. It consists in passing a narrow cloud-jet parallel to the axis of a cylindrical electric precipitator and measuring the charges acquired by the particles. The flowing particles are sucked into an ultramicroscopic cell for the measurement of the mass and the charge of the particles by the photographic oscillation method which has been developed on the basis of an ingenious idea of Wells and Gerke.* The particles

* References are to the pages in the Monograph (*Trans. Faraday Soc.*, 1936, 1042–1297).

* *J. Am. Chem. Soc.*, 1919, **41**, 312.

are allowed to fall under the force of gravity and at the same time are compelled by an alternating electric field to oscillate in a horizontal direction. Photographing the zig-zag paths of the particles, the size is determined from the rate of fall and the charge from the horizontal velocity. Experiments were made with oil droplets of $0{\cdot}5\,\mu$ to $3\,\mu$ in radius. There was good agreement with theory when the effects due to mirror forces and diffusion of ions were neglected.

Electrostatic and Thermal Precipitation of Aerosols.

Mierdel and Seeliger (p. 1284) have discussed the general principles involved in electric precipitation. Meek and Lunt (p. 1273) have examined the conditions observed in electrostatic precipitation in view of Prinz's theory. Cawood (p. 1068) as well as H. W. Watson (p. 1073) have discussed the factors contributing towards formation of dust-free space around hot bodies. The latter has discussed the theory of his dust sampling apparatus (which is based on the principle of thermal precipitation).

Dispersoids in Country and Town Air.

Dobson (p. 1149) has dealt with the nature and the formation of fogs. Fogs are caused in a humid atmosphere by the condensation of water vapour on hygroscopic nuclei. Near industrial towns, the nuclei consists mainly of sulphuric acid droplets. In the country air (particularly near the sea-coast) sea salt particles function as nuclei. The size of the fog droplets depends upon the humidity of the atmosphere and the surface tension and osmotic pressure of the liquid constituting the droplet. The size of the droplets—rather than their number—determines the haziness of a fog. The red appearance of the sun through a town fog is due to the presence of a large number of minute dust particles in the atmosphere and not to the droplets which are much larger in size (being a few microns in radius). Kohler (p. 1152) finds the chlorine content of fog droplets to be of the same order as that of rain drops. Arguing on the assumption that the chlorine salts are the nuclei, he concludes that rain drops are not formed by the direct condensation of water vapour on the fog droplets. The nature of the dispersoids usually present in country and town air has been discussed by Coste (p. 1162). Town air mainly contains tar, coke, sulphur dioxide, ammonia, nitrous fumes, etc., all obtained from flue gases. Pollution depends upon the locality as well ; thus iron oxide is generally found near railway stations. The organic suspensions consist of hairs, moulds and bacteria. Coste and Courtier (p. 1198) have investigated the sulphuric acid content of London air. The cause of several deaths and respiratory troubles brought about by the persistence of a fog for five days in the Meuse valley (Belgium) in December 1930, has been traced by Firket (p. 1192) to the sulphur dioxide present in the fog. Whipple (p. 1203) has shown by the examination of the data obtained at the Kew Observatory, that the electrical resistance of the atmosphere increases throughout the hours when pollution is occurring. This is ascribed to the capture of the positive ions by dust particles. Owens (p. 1234) in his paper on " Twenty-five years' progress in smoke abatement " has discussed the work carried out by the " Advisory Committee on Atmospheric Pollution " and has briefly indicated the broad conclusions obtained from statistics gathered at different stations.

Natural Dissipation of Aerosols and Their Practical Removal.

Bosanquet and Pearson (p. 1249) have carried further their mathematical analysis of phenomena involved in eddy diffusion in the spread of smoke and gas from chimneys. Meldau (p. 1270) has shown how fog and dust may first concentrate at unexpected places, sometimes quite remote from their place of origin and how it cannot be explained merely on the basis of wind direction. Goodeve (p. 1218) has described a centrifugal type of mist remover. Lessing (p. 1223) has dealt with the various factors that cause dust in atmosphere and has discussed the relative merits of the several methods of purification. Nonhebel (p. 1291) has described a commercial plant for the removal of smoke and oxides of sulphur from flue gases. The dissipation of fog by electrical, mechanical, thermal and chemical methods has been studied by Brunt (p. 1264). The thermal method seems to have many limitations. The chemical method, however, is more promising. It consists in destroying the equilibrium between the fog particles and the medium by the introduction of a hygroscopic substance like calcium chloride and the consequent evaporation of the fog particles.

The above review of the subject matter contained in the monograph—brief as it is—is sufficient to show the diversity of the points of view from which the study of dispersoids in gases has been approached. The monograph would no doubt be read with great advantage by all those who are interested in the subject.

B. Sanjiva Rao.

A Currency for India.

By Maurice Frydman.

(*Engineer Superintendent, Government Electric Factory, Bangalore.*)

IN the beginning, articles of human need were simply bartered and the rate of exchange depended on the relation between demand and supply. With development of the agricultural life and trade the necessity of standards of value arose, and it is remarkable, that the first standards were based on articles of immediate necessity: grain, cattle, cloth. Further development of trade created a need for an easily portable standard and first metal in general and finally gold was adopted. Adoption of a gold standard used at that time for jewellery and vessels only, coincides with a very high degree of general prosperity, when the demand for articles of first need was satisfied to a great extent, and when trade was catering to big towns and courts. Political development introduced State treasuries and a problem of replenishing them—large payments had to be made and this led to standardised metal pieces, called coins. Kings, usually badly in need of means of payment, manipulated with the coins, and their value decreased steadily, or in other words, prices were going up. Development of banking introduced paper values, which later developed into paper money by the same process of State manipulations. Ultimately paper money has replaced gold coins everywhere and gold has become now an article of trade, like any other, while currency and prices are ruled mainly by legislation.

The tradition of basing the value of paper money on the amount of gold the State will pay on demand is becoming more and more obsolete. There are very few States that will freely give gold to their citizens in exchange of paper notes. In international relations payment in gold is still current, but the general tendency towards balancing the imports and exports whenever possible by means of commercial treaties or currency depreciation has for its main purpose the elimination of gold from international relations.

The fallacy of gold as standard of value can be well shown if we take an extreme example.

A country called *Eldorado* is lined with gold bricks, but is, apart from this, completely barren. Its inhabitants will pay with gold for war material to protect themselves and other goods to maintain themselves. The gold received in payment by the countries producing goods will be stored up in bank vaults and paper money issued to finance industry and agriculture to produce more goods demanded by our *Eldorado*. Provided the supply of gold bricks is big enough, the *Eldorado* State will flourish without producing anything, while other States will slave for it. The accumulation of war material may even lead to a political supremacy of *Eldorado* and all because other States have a fancy for hoarding up gold in their treasuries.

This may be an indirect test, but direct tests also show the unsuitability of gold as standard of value. The history of the last few hundred years of the West is a history of mankind suffering from gold poisoning. The production of gold does not go parallel to the development of the means of production and this leads to deep anomalies in the world trade and to periodical depressions. To consider them as natural would be to consider periodical attacks of malarial fever natural. They are signs of disease, of lack of balance between production and consumption, in short, of an unsound currency system.

The gold standard is also not moral in the sense of interfering with the self-evident right of every individual to self-expression". The shifting of the centre of gravity on a substance which is not an article of immediate and universal need has dislocated the attitude to life of the average man. Possession, and not service has become the goal. Everybody wants to have something, and not to be something and to do something. The harm, such mental distortion of outlook is doing to the individual and society cannot be over-estimated. Imagine the cells of your body obsessed with the idea of getting fat; some tissues, capable of collecting fat will become monstrously obese, while others, the brain and the nervous system first amongst them, will suffer acute emaciation. The bankers of the system, the heart and the liver will accumulate fat and will work lazily, which will lead to still bigger deposits of fat in some of the tissues.

To say that the same happens in our present-day society will not be an exaggeration.

To improve matters a change of attitude towards money is necessary. Gold is a static standard, it encourages possession, and not production and consumption.

Enormous amounts of human effort are spent on digging out the gold from one pit, called "mine" for putting it into another pit, called "bank". Since gold does not satisfy human needs, it stands to reason that the labour is a complete waste. As a matter of fact paper currency could be issued on the basis of the gold content of the soil of the country with the same effect.

The very chemical stability of gold, praised by its partisans is rather a drawback. A depreciating currency would be infinitely better for the general welfare. But a depreciating currency alone would not be sufficient.

We do not maintain that currency reform alone will heal all wounds. It is not possible. Currency is only a tool, a technical detail of social organisation; but the right choice of a tool may have a far-reaching influence. Give mankind a standard of value that favours accumulation—it will accumulate. Give it another standard, that will encourage production and consumption—it will produce and consume with the same enthusiasm.

In our search for the most suitable form of currency for India we shall take the country as it is, and not as we would like it to be.

The main problem of India is the problem of a most appalling poverty, probably even worse than in China. One-fifth of humanity is living on or below the mere level of subsistence. The average income of an Indian is 7ps. per day.

Poverty cannot be abolished by State or private charity, however generous and extensive.

One may be fed on doles, " Winterhilfe ", " Soupes popularies " or " National relief funds " and yet remain in the same state of wretchedness. All the unemployment schemes, etc., are nothing but production of beggars on a mass scale. Workmen dislike intensely these schemes; unearned bread is tasteless for them. They postpone physical starvation, but mental and moral starvation remain the same. Vast millions are reduced in their human dignity and their capacity for work is wasted.

In India no unemployment or poverty-relief is yet organised. It is natural because poverty and unemployment are too general. Contrary to other countries, total employment is the privilege of a minority here. The vast majority of the population is partially or totally unemployed. All the resources of the employed part of the population will not be sufficient to finance even the most modest unemployment scheme.

Complete abolition of poverty involves a thorough economic reconstruction of which a currency reform is a single aspect only.

Whether it will take in India the shape of a State socialism, or of a God socialism, it is not for us to venture an opinion.

Thus, the system of currency we are in search for, should be designed so that its working automatically tends to diminish poverty, in other words: (1) It will favour production; (2) It will facilitate proper distribution; and (3) It will encourage consumption. Apart from this the proposed currency should be easily understood and accepted by the poverty-stricken man himself, *i.e.*, it cannot be an abstract currency, based on price indexes or other statistical averages.

In looking through the list of human needs we find that the first is food. Its importance is out of proportion to any other. In moments of distress the satisfaction of all other needs will be sacrificed for the sake of food and family affection only proves sometimes equally strong. Food being the first necessity it is also the biggest single item of man's production. More effort is spent on the production of food than on everything else taken together. Food is also the item in which insufficiency of production, distribution and consumption is most intolerable. It makes the availability of all other necessities of life worthless.

Let us imagine that by some magic, India is deprived of all amenities of civilisation but given an abundance of pure and healthy food. A nation of well-built nudists, walking briskly from Rameshwaram to Badrinath for a stroll, begetting sturdy little boys and girls in a happy promiscuity, worshipping, if at all, *Sri Annapurna* only and friendly to each other because there would be absolutely no reason for being otherwise, may look grotesque to our worry-eaten minds, but whoever loves man for his own sake will not deny that it would be an acceptable proposition.

Food being the first and by far the most important need of man, which, when required, will be willingly exchanged against anything else, the following idea occurs immediately.

Why should not the most common and urgent necessity be made a standard of value? Will it work better? Will it fulfil the requirements of India? Will currency based on a food standard be *the* " morally sound currency " system for India?

The first thing to note is that a food currency is not a new idea. It exists and works on a small scale in all purely agricultural communities. It still exists in the Indian village economy. It is in harmony with Indian traditions. It is in the very blood of the villager, and the villager *is* India.

In ancient times gold coins were stored by tradesmen, kings and temples; the villager knew paddy only. Till very late even taxes were paid in grain and the only contribution to be paid in gold and silver were the homages offered to the ladies of the household.

The introduction in India of a foreign economic and industrial system has destroyed the village economy and ruined the very foundation of the country's prosperity. Everything had to be paid with money, with *rupees*, *annas*, *pies* and money has become a nightmare. Its value in terms of grain was changing constantly. Significant is the fact that the villager says: " so many measures of rice for a rupee " and not " so many rupees for a measure of rice ". It is because he had to purchase rupees, and never rice. He had to purchase rupees for payment of taxes, debts, implements, cloth, etc. Yet, in his mind, grain remained the standard of value and not money, which he had to get to pay off all his harassers till the next season.

Let us now make clear, what exactly we mean by the term " food currency "; with its introduction, what would be its influence on the agricultural and industrial life of the country, in what way will it affect production, distribution and consumption and how will it influence Indian trade relations with other countries.

By " food currency " we understand a system of currency in which a staple food product of the country is taken as a standard of value. In India it will be a chosen variety of paddy and wheat. A certain quantity of paddy and an equivalent from the nutritive point of view, quantity of wheat will be chosen and called a rupee. To distinguish it from the old rupee the new rupee may be named *food-rupee*. For purposes of convenience the food-rupee standard may be so chosen, as to represent the value of a rupee in terms of grain at a rate most suitable from all points of view.

Legislation will have to be passed: (1) to convert all gold obligations; (2) to control the import and export of currency grains; (3) to open State granaries, (4) to fix once for ever, the quantity of currency grain in a *food-rupee*, (5) to fix the seigniorage levied by the State when exchanging currency grain for currency notes.

The seigniorage is necessary to avoid the Government to become a merchant in grain. It may be one to two annas in the rupee, which will allow a margin of profit to all big and small grain merchants that will continue their trade within the limits of seigniorage, similar to the gold brokers of to-day.

The State granaries do not need to be many nor very big, if free railway transport of State grain is introduced, every station master may be authorised to issue food currency notes against currency grains and send the bags of grain to the State granaries.

Private hoarding of food currency notes will be prevented by proper legislation devaluing old currency notes, unless deposited in savings banks.

An additional legislation of immense importance, although not directly connected with the currency reform would be the transfer of a part of land revenue to a Crop Insurance Fund, out of which compensations for total or partial crop failures will be paid.

Let us now visualise the change as clearly as we can. We shall assume that the reform is already about 3 years old, and the storm of protests, declarations, petitions, resolutions and interpellations has subsided and the big grain merchants have chosen another field of money-making, that the villagers have thoroughly learned the welcome news that there will be no more variation of price of crops, however abundant the crop may be and the grain consumer has also learned that he does not need to pay grain above a certain rate, printed on every currency note in his pocket. The grain ports are usually deserted. Apart from this not much more changes will be found in the towns.

The real importance of the reform will be seen in the village. Every plot of land becoming virtually a gold mine and every villager a gold digger, unusual activity is observable everywhere. Grain has verbally become money—by growing grain money is grown—and everybody knows well in advance how much money is going to be grown. Every piece of land is utilised, irrigation schemes are put to execution, the selected grain varieties are sought for, agricultural improvements quickly popularised, best implements purchased, every village humming with activity, because for the first time in history the grain grower is sure of the crop, its price, its market.

Demand and supply relations govern other agricultural products, and their culture will not be forsaken, as their price will be always controlled by the value of grain that can be grown on the same land with the same amount of labour and usually they bring some small premium to the enterprising grower.

Every villager knowing exactly how much value he is growing every year, is enabled to lay out a budget and to have his own private 5-year plan. The indebtedness of the village has become possible to cope with, as the stabilised income of the villager has enabled the State to give long-term interest free loans on the security of the crops.

The industrial development of the country is tremendously accelerated. The currency notes the villager receives for his grain he has either to spend or to save. He spends on industrial products like carts, bullock shoes, lamps, hardware, paper, etc. The amounts saved are utilised by the Government for financing big irrigation and electrification schemes, reclamation of waste lands, building roads and railways. In both cases the money goes to the industries. As the industries develop and their own costs go down, prices of industrial products in terms of agricultural products go down, enabling the villager to purchase more and more. Thus the development of industries follows closely the rise of prosperity in the villages.

The State has profited in several ways. Its land revenue is stabilised and growing from year to year. The seigniorage has created a new source of income. The prosperity of the population is increasing steadily, any local famine is dealt with by the Crops Insurance Fund, and there is plenty of reserve funds for any major scheme. Food, being the currency itself, no need of curtailing its production is ever felt; when abundant quantities accumulate in the granaries, extensive sanitation, town building and road building schemes are financed, educational facilities extended and children, maternity and old-age protection schemes introduced. Heavy inheritance taxes curtail the accumulation of too big savings, money is grown intensely and spent intensely and proper balance between production and consumption maintained all the time.

Except for the severe control of currency grains imports and exports, little change can be observed in the international trade mechanism. The *Food-Rupee* being an internal currency, the international trade accounts are cleared by a special bank agency which keeps foreign money and gold stock for smoothening out the differences between exports and imports. The country's gold production, useless now for the internal economy, is more than sufficient to meet any foreign obligation, if they have to be paid in gold.

Needless to say that although the food currency will make a tremendous difference in the economy of the country and may open a new era in its development, as long as the land will be in the hands of landlords, it will make them very rich and also very dangerous. The new scheme will benefit them in the first instance. The tenants, usually left with just enough to live on till the next season, will get their benefits only indirectly, owing to increased demand for industrial and rural labour.

Yet any failure to give plenty to every individual in India will not be the fault of the currency system, but of other aspects of the present economic structure. The scheme by itself is able to foster production, facilitate distribution and increase consumption.

Can the reform be introduced immediately? Surely. It will make everybody's life easier. It requires a very simple legislation. It benefits the State and the citizen in the same measure.

Can it be introduced in a smaller area than the whole of India? Yes, provided two conditions are fulfilled:

(1) The chosen area can grow some excess of food over the needs of the population; (2) Its revenue is entirely independent and it has no outside charges; and (3) It has got freedom to regulate its imports and exports.

Some objections may arise and it will be useful to answer them in anticipation.

(1) Is it necessary to make food the currency itself? Will not a grain price policy based on State granaries do the same?

No, it will not do, as although it stabilises the prices to a certain extent, it will always be subject to the whims of the Governments and does not give the certainty, that the food currency itself can only give. Apart from this, the gold poison will not be eliminated.

(2) Will not a food currency lead to over-production of grain? No, because human needs are various and with the increase of prosperity the population will create a demand for other agricultural products, that will become more paying to produce, than grain.

(3) The food currency will foster barter transactions in the rural areas, with the elimination of currency notes.

It would be a welcome procedure, eliminating the middleman completely and giving to those concerned the full value for their services.

(4) It will be difficult to collect taxes in grain.

Taxes will be collected as usual, in currency notes. Exchange of grain against currency notes is done separately, preferably by the station masters.

(5) The State will incur heavy losses by accidental deterioration of grain.

The modern granaries can keep grain for very long periods. If the reform is passed by the Government, we undertake to design air conditioned and ventilated granaries in which grain will keep as long as in the Egyptian Pyramids.

(6) A heavy load will be put on railways.

Not at all; State granaries will not be big at all. The majority of grain transactions will pass through private hands, who will desire to profit by the seigniorage. Apart from this the increased railway traffic, due to higher prosperity, will pay off the railways generously the necessity of sending a trainload of grain free.

(7) Excess of grain will accumulate in State granaries.

Grain is a starting point in a variety of chemical industries. It can be dumped away by the State. A large percentage of currency notes issued will never be claimed to be exchanged for grain and the excess of grain can be sold to licensed chemical industries at lower rates or exported.

It is impossible in a single article to go into all the details of the scheme and to discuss all the corollaries. However utopian it may look at the first sight, it is a simple, understandable scheme. It deserves consideration—and we are sure that a generation will come that will take it seriously and put it to practice.

Stratosphere Flight in the Balloon "Explorer II".*

IN the issue of *Current Science* for April 1936, a brief summary was presented of the balloon ("Explorer I") expedition into the stratosphere; it was organised and conducted in the U.S.A. under the joint auspices of the United States Army Air Corps and the National Geographic Society. This hydrogen filled balloon with a volume of 3,000,000 cubic feet, made and equipped with meticulous care began to give way at a height of about 61,000 feet and ended in disaster; the three heroic fliers had to jump out of the gondola hurtling down under its own weight and save themselves by parachutes.

Nothing daunted, preparations for a second balloon expedition were almost immediately organised; this second balloon—"Explorer II"—was bigger by 70,000 cubic feet and filled with helium instead of hydrogen to avoid all risk of explosion. As in the case of the previous expedition, a large number of scientists and scientific institutions, firms and government departments enthusiastically co-operated in the great adventure. The gondola was again a remarkable floating laboratory equipped to carry out an amazing variety of scientific measurements and observations, all automatically recorded; nature, intensity and directional distribution of cosmic rays; atmospheric ozone distribution; electrical conductivity; composition of air; pressure, temperature and wind velocity variations with height; micro-organisms in the stratosphere, etc.

On 11th November 1936 (Armistice Day), leaving the Stratobowl near Rapid City at 7 A.M., "Explorer II" safely returned to earth eight hours later, after a remarkably successful flight to the record height of 72,395 feet. The details of the flight and the preparations for it are very vividly, and with humour, described by Major Stevens, the Commanding Officer.

The theoretical and practical considerations underlying the design and construction of the balloon and the gondola; the radio telephone communication system by which the balloon was in touch with the earth throughout; the photographic and recording arrangements; the apparatus and operation for the large number of scientific observations and their automatic recording; all these are described in appropriate detail, supported by a large number of line diagrams and excellent photographs.

The results of the examination and analysis of the various records and specimens are reported in a series of scientific articles occupying nearly two-thirds of the volume. Each of these is written by a specialist. As in the case of "Explorer I," cosmic ray investigations occupy a prominent place.

The general reader will be interested to know that the electric potential at 72,000 feet is some 400,000 volts above earth and 100,000 volts above the value at 16,500 feet. Though the air pressure is no more than about 35 mm. of mercury, the wind velocity at 70,000 feet is so high as 40 miles an hour. No wonder that under this churning action, the composition of the air at these heights differs really little from that at sea-level. Of no small significance is the evidence from the cosmic ray records that nuclear disintegrations can take place without the capture of the incident particle.

For the specialist as for the general reader, the book will be very interesting reading.

A great adventure in every way, finely planned and carried out.

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* *The National Geographic Society—U. S. Army Air Corps Stratosphere Flight of 1935 in the Balloon "Explorer II,"* Stratosphere Series No. 2, published by the National Geographic Society, Washington, 1936; Price $ 1·50.

SCIENCE NOTES.

Coronation Honours.—The names of the following men of science are to be found in the list of the recipients of the Coronation Honours:—

C.I.E.—Lieut.-Col. C. Newcomb, Chemical Examiner to the Government of Madras; Mr. J. F. Blackiston, Director-General of Archæology in India; Mr. F. Ware, Officiating Expert Advisor in Animal Husbandry to the Imperial Council of Agricultural Research, New Delhi.

Knighthood.— Brigadier H. J. Couchman, Surveyor-General of India; Col. Arthur Alver, Expert Advisor in Animal Husbandry to the Imperial Council of Agricultural Research.

Dewan Bahadur.—Dr. B. Sundar Raj, Director of Fisheries, Madras.

Rao Bahadur.—Prof. K. Ananda Rao, Presidency College, Madras.

Rai Bahadur.—Mr. Ramalal Sethi, Economic Botanist to Government, Government Research Station, Shahjanpur, U.P.; Dr. Sundarlal Hora, Zoological Survey of India, Calcutta; Dr. Karamchand Mehta, Professor of Botany, Agra College, Agra.

Rao Saheb.—G. K. Kelkar, Deputy Director of Agriculture, Southern Circle, Nagpur.

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Spinning Tests on Mixtures of Staple Fibres and Indian Cottons.—Dr. Nazir Ahmed, Director of the Technological Laboratory, Indian Central Cotton Committee, has written an interesting report (*Technological Bulletin Series*—A, No. 36) on spinning tests carried out on mixtures of staple fibres and Indian cottons. In the Introduction it is pointed out that the past few decades have witnessed a large increase in the use of artificial fibres as a supplement to, or substitute for, natural fibres, in which rayon silk has held the first position. Rayon produced in short definite lengths, called staple fibre, went up from 8 million pounds in 1931 to 21 million pounds in 1932 and then to 156 million pounds in 1935 which represented 15 per cent. of the total rayon output. This large increase is attributed to the fact that staple fibre possesses uniform length and cross-section, it is clean and therefore there is very little waste and it does not adhere to the machine. But the more important reason is that it can be mixed and blended with cotton, wool, flex and silk and spun on the existing machines with some minor adjustments. The spinners, weavers, dyers and finishers can therefore produce a wide range of effects with it.

The Bulletin gives full details of the machinery employed in these tests and the results obtained are described and discussed in detail. It is hoped that it will be found useful by the industry. It can be had from the Secretary, Indian Central Cotton Committee, 'Vulcan House', Nicol Road, Ballard Estate, Fort, Bombay, at 8 as. per copy.

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The Sugar Committee of the Imperial Council of Agricultural Research, held a two-day session (May 3rd and 4th) to discuss the various problems affecting the sugar industry. Sir Bryce Burt presided. The Committee considered the serious situation arising from the alarming expansion of the acreage under cane, resulting in the production of cane far in excess of that for which there is effective demand. In this connection it is hardly realised that the cane crushed in factories for manufacturing white sugar is 11¼ million tons, which is only about 16 per cent. of the cane produced in the country. Some 12 million tons are consumed mostly by chewing and no less than 43¾ million tons go into the manufacture of *gur*. An enormous quantity of cane is still left over. In a contribution appearing in the '*Hindu*' (May 1) Mr. D. P. Khaitan has given some interesting details regarding the Indian Sugar Industry. The production of sugar in India in 1932, when protection was granted was 158,581 tons, and 516,200 tons valued at about 6 crores of rupees were imported from abroad. It is roughly estimated that the annual consumption at present is nearly 12 lakhs tons, and in 1935–36, no less than 1,166,000 tons of sugar were produced in the country, the production being almost equal to the annual consumption. The acreage under cane was 3,076,000 in 1931–32, and in 1936–37 the acreage rose up to 4,431,000. It is estimated that no less than 2 crores of the whole population of India is dependent on the cultivation of sugarcane and the total amount paid to the cultivation of sugarcane used in the factories 'uring the last year, 1935–36, alone came to Rs. 8 crores.

The distribution of the area under sugarcane in India is ill-ordered. The prevailing system of land tenure and the existence of small holdings constitute a handicap. The cultivation of canesugar should be spread over specially marked zones so situated that particular factories can draw the raw material they require from those zones; in other words the factories should enjoy a situational advantage. How best this could be secured, was one of the problems which was carefully considered by the Committee.

The Sugar Committee approved of the proposals for carrying out a proper marketing survey of sugar on the same lines as those adopted for the wheat survey. The Committee also considered the research programmes and work now in progress in the various experimental stations for evolving improved varieties of cane. The subject of utilisation of molasses was also considered; further trials relating to (1) the preparation of silage by mixing molasses with fibrous fodder and (2) the utilisation of molasses as a road-surfacing material will be carried out in order to relieve the sugar industry from the dead-weight of its by-product.

It is understood that representatives of the sugar industry have urged on the Government, the need for constituting a Central Sugar Committee on the lines of the Indian Central Cotton Committee to co-ordinate and guard the interests of the industry, by research, propaganda and other methods.

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Red Palm Oil.—"The nutritive value and cost of the Red Palm Oil" is the subject of a communique recently issued by the Director of Public Information.

The oil derived from the fruit of the West African Palm, *elæis guineensis*, is very rich in

carotene, the precursor of Vitamin A. Chemical tests conducted by Lt.-Col. R. E. Wright, I.M.S., Professor of Ophthalmology, Government Ophthalmic Hospital, Madras, have shown that red palm oil is as effective as cod liver oil in the treatment of several cases of human keratomalacia. In a number of cases rapid improvement took place in cases which remained living under the identical domestic conditions in which they had developed the syndrome, the only change in their daily routine being the addition of red palm oil emulsion to their diet. In addition, the progress of cases in hospital on red palm oil and cod liver oil was carefully compared. While Colonel Wright points out that clinical investigations of this nature are necessarily less clearly defined than laboratory investigations under carefully controlled conditions, he has nevertheless fully convinced himself of the effectiveness of red palm oil. The decision of so experienced a worker can be accepted as conclusive.

If red palm oil cures keratomalacia, then its carotene must be capable of satisfying the daily Vitamin A requirements of human beings.

Considering the costs, it has been calculated that the amount of Vitamin A purchasable for a given sum in the form of red palm oil will be about 3 times greater than that purchasable in the form of cod liver oil. The fact that red palm oil contains little or no Vitamin D, unlike cod liver oil, is not necessarily a drawback to its use in countries where Vitamin D is supplied by abundant strong sunlight and rickets is rare. In India, it could be used in the South and other parts where Vitamin A deficiency is common and Vitamin D deficiency not a serious problem.

The question of introducing the palm *elæis guineensis* into South India should receive attention on the part of agricultural authorities. The climate of South India would probably be suitable for its cultivation.

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The Statistical Institute.—The Annual General Meeting was held at Calcutta on the 27th April with Mr. S. P. Mookerji in the chair. The report of the research work done during the year comprises a variety of subjects such as, Agricultural Statistics, Biometry and Anthropometry, Economic Statistics, etc. Over 100 statistical enquries from all over India were attended to during the year. An important decision was reached to start an All-India Statistical Conference to be held in January 1938, and a Working Committee was formed to work out the details. With the help of the Calcutta University, arrangements have been made to invite Prof. R. A. Fisher of London, to visit India next winter.

Sir E. C. Benthall was re-elected President and Dr. P. N. Banerji, Sir George R. Campbell, Mr. D. P. Khaitan, Dr. John Matthai, Mr. S. P. Mookerji, Dr. C. W. B. Normand, Sir. C. V. Raman, Lala Shri Ram, Prof. M. N. Saha, The Hon'ble Mr. Nalini Ranjan Sarkar, and Mr. B. M. Sen were elected Vice-Presidents. Dr. Satya Charan Law was re-elected Treasurer.

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Indian Chemical Society.—At the ordinary meetings of the Society held on 4th March and on 23rd April at the University College of Science, Calcutta, the following were admitted as Fellows :—

(1) D. G. Walwalkar, M.Sc., *Cawnpore*; (2) M. A. Saboor, M.Sc., *Calcutta*; (3) Dr. U. Basu, D.Sc., *Calcutta*; (4) Dr. P. B. Sarkar, D.Sc., *Calcutta*; (5) A. Kamal, M.Sc., *Calcutta*; (6) Sisir Kumar Guha, M.Sc., *Patna*; (7) N. N. Chopra, M.Sc., *Lahore*; (8) Aree Supol, B.Sc., *Bangkok* (Siam); (9) Dr. R. K. Dutt-Roy, Dr. Ing., *Calcutta*; (10) S. A. Qureshi, B.Sc., *Peshawar*; (11) R. G. Chatterjee, M.Sc., *Darjeeling*; (12) D. P. Chatterjee, M.Sc., *Howrah*; (13) Dr. J. C. Bardhan, D.Sc., *Calcutta*; (14) G. N. Banerjee, B.Sc., *Bombay*; (15) M. Abdul Hamid, M.Sc., *Bombay*; (16) Narendra Chandra Deb, M.Sc., *Sylhet*; (17) Dr. R. C. Hoon, M.Sc., Ph.D., *Lahore*.

Dr. S. P. Roy Chaudhuri, delivered a lecture on the 23rd April on "The Nature of laterite and lateritic soils"; Prof. J. N. Mukherjee presided.

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Hyderabad Geological Survey.—*Bulletin* No. 2 recently published by the Geological Survey, Hyderabad (Deccan), under the authorship of Mr. Khurshid Mirza, Director, gives a brief outline of the geological history of Hyderabad State, with special reference to its mineral resources. In the course of the first 30 pages, the author gives a connected account of the main geological features of the State incorporating all the information hitherto collected; and in the latter half of the *Bulletin* which covers another 30 pages, attention is drawn to the deposits of economic value, of which a large number and variety have been located. The *Bulletin* will doubtless be found very useful by those who wish to have a general idea of the geology of this State, and the geological map given at the end greatly adds to the value of the publication.

Volume III, Part I of the *Journal of the Hyderabad Geological Survey*, which has also been recently published, contains three sections of which Section A is by far the biggest and deals with the geology of the eastern portion of the Raichur Doab, with special reference to the granodioritic phases of the Dharwar series of rocks. The paper embodies the work done in this area by the several officers of the Survey and gives an elaborate account of the various rocks met with in this part of the country representing the Dharwars, the Peninsular Crystalline Complex, and the Kurnool Series of Sedimentaries. The petrology of some of the more interesting rock groups such as the granodiorites and the pseudo- and quasi-charnockites has been studied in some detail and certain interesting conclusions drawn. Section B deals with the salinity in relation to soil and geology in Raichur District, and in Section C, we have an account of the Bore Well logs in Aurangabad and Parbhani Districts, discussed in relation to the distribution of underground water in the Deccan traps.

The *Journal* is well got up, and is profusely illustrated with maps, sections and photographs.

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Asphalt Mastic for Roofing.—The modern demand for waterproof flat roofs has given prominence to a number of problems connected

with the use of asphalt mastic as a roofing material. A recent report published by H. M. Stationery Office (*Building Research Special Report* No. 25, Price 9*d*.) brings together in convenient form the available information on the properties of the material and methods of testing it. The construction of the sub-roof and the laying of the mastic are described in full and a feature of the report is a set of drawings illustrating accepted practice as regards associated details. In the absence of a standard specification for the formulation of which present-day knowledge does not suffice, recommendations are made as to the selection of materials and the precautions to be taken in their use.

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Cytological Technique for Plant Breeders.—As Sir Daniel Hall says in a brief foreword to this Bulletin, a knowledge of cytology and some acquaintance with its technique has become essential to the plant breeder. The aim of the publication is to give an account of the standard methods used in plant cytology and it is based on practical experience with these methods rather than on a survey of the literature.

After an introduction dealing with the value of cytology in plant breeding and some general remarks on technique, the Bulletin describes in turn the paraffin method, including staining with iron-alum hæmatoxylin and with gentian violet, the aceto-carmine technique (a method particularly useful for plant breeders) and smears with standard fixatives and stains. Hints are given on the use of the microscope and the Bulletin concludes with a list of fixatives with formulæ and a short bibliography.

While the Bulletin has been prepared for the benefit of plant breeders, it is of course equally suitable for anybody wishing to learn these standard methods; the modest price is worth mention in this connection.

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Tooth Decay Studied by X-Ray Absorption of Tooth Slabs.—New data with regard to normal and pathological tooth conditions have recently been obtained by Drs. H. C. Hodge, S. L. Warren, G. Van Huysen and associates, of the Dental Research Group at the University of Rochester School of Medicine and Dentistry, by the use of thin tooth slabs which are surface-ground plano-parallel by the BAUSCH & LOMB OPTICAL Co. with a variation of not more than ±0·01 mm.

Attempts by other investigators to study changes in dentine by X-ray absorption have been limited because tooth slabs were not sufficiently thin or plano-parallel, thus reducing the precision of film density measurements.

In the present method several slabs of teeth, about 1 mm. thick, are obtained by slicing a tooth longitudinally through its centre by means of two parallel, corundum-vulcanite disks on a watchmaker's lathe, after which they are ground plano-parallel.

Dr. Hodge and his associates are seeking the answer to tooth decay by a study of the physical, chemical, and structural make-up of the tooth and the effect of diet and heredity. Some of the properties measured have been hardness, X-ray absorption and diffraction, chemical composition, density, refractive index, and the sizes of the tiny calcified rods that make up tooth enamel, and the smaller tubules that run out from the tooth pulp through the dentine.

According to their report, when menaced by decay or wear the tooth protects its health by building a dike of calcified material between the danger zone and the living pulp. These changes can be measured by X-ray study of the plano-parallel tooth slabs whose thickness does not vary more than 1/2500 of an inch.

When teeth wear down, exposing the dentine, the tooth closes the inner end of the tubules affected by building a plug of dentine which is as transparent as glass. To measure the hardness of these areas the surface of the tooth is illuminated with vertical polarized light which shows the transparent area as a dark area on a white background.

These studies have disclosed, among other things, that some teeth are as hard as mild steel and that dentine is as hard as brass.

By the use of the thin tooth slab, which may be X-rayed at will, the limits of accuracy and reproducibility of the method may be measured quantitatively, an achievement which has not been possible in living material.

The substitution of monkey teeth, which are nearest the human type and which suffer the same diseases, are to be included in future studies. The question as to whether soft teeth decay more rapidly than hard ones, and why, will not be answered until some 2,000 additional teeth are studied.

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Attempt on Nanga Parbhat.—The members of the second German Expedition to conquer Mt. Nanga Parbhat consisting of Dr. K. Wein (leader) and eight others are now in India and will start the climb after reaching Gilgit, by about the end of May. It is anticipated that the climb will lost about 4 weeks.

It will be recalled that an attempt was made by a German party three years ago but the attempts were foiled by the early onset of monsoon. The expedition also lost four of its members in a snow-storm. The present party consists of Prof. C. Troll and Dr. H. Hartmann, eminent geologists, who propose to collect scientific data during the climb.

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Statistical Abstract for British India.—The Government of India have recently issued the *Statistical Abstract for British India* with statistics, where available, relating to certain Indian States for 1924–25 to 1933–34. This is the 13th issue of the *Abstract*. The statistics presented relate to a variety of subjects such as Area and Population, Police and Prisons, Registration, Finance, Coinage and Currency, Banks, Municipalities, District and Local Boards, Education, Press, Co-operative Societies, Agriculture and Law, Forests, Port Trusts, Emigration, Vital Statistics, Road, Railway and Steamer communications, Trade, Posts and Telegraphs, Meteorology, Irrigations, Industries, Patents, Mineral production, etc., etc. The statistics relating to Agriculture and Co-operative Societies generally relate to the year running from July to June. All the other tables relate either to the fiscal year ending 31st March, or to the calendar year and where the latter is the case the fact is clearly indicated in the tables.

Maynard Ganga Ram Prize.—Prof. R. S. Jai Chand Luthra, I.A.S., Professor of Botany, has been awarded the prize for 1935, in consideration of his researches on the Control of Loose Smut of Wheat. This disease is prevalent in most parts of Punjab and causes considerable loss to cultivators. The old method of control involved treatment of the wheat before sowing with hot water and unless carried out by skilled workers, it was prone to affect the germinating power of the seed. Prof. Luthra's method which is far simpler, consists in treating the seed merely in water at ordinary temperatures for four hours during the morning of a day in summer, after which the soaked seed is spread out to dry in the sun. Experience has shown that this treatment is effective in controlling the disease.

The award for 1932 has also now been announced. The recipient of the prize is Mr. T. A. Miller Brownlie, lately Agricultural Engineer to Government, of Punjab, for his invention of a slip strainer suitable for water augmentation of supplies derived from bores sunk in open wells. This strainer has the particular merit that it is not affected by alkaline sub-soil water.

The award which is of the value of Rs. 3,000 is due to the munificence of the Late Sir Ganga Ram, Kt., C.I.E., M.V.O., R.B., who in 1925, handed over to the Punjab Government a sum of Rs. 25,000 for the endowment of a prize, to be awarded every 3 years for a discovery or an invention or a new practical method which will tend to increase agricultural production in the Punjab on a paying basis. The competition is open to all, throughout the world.

The first award which was due in 1929 was made in 1931, to Dr. Barber, late Imperial Sugar Expert, for his fundamental discoveries which resulted in the production of Coimbatore Sugarcane.

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Rao Bahadur M. Vaidyanathan, Statistician, Imperial Council of Agricultural Research, has been granted study leave for 8 months. He will be visiting the United Kingdom, where he will study problems connected with Agricultural Experimental technique in collaboration with the foremost Statisticians of England, Prof. Fisher, Wishart and Yates.

Rao Bahadur M. Vaidyanathan will be sailing from Bombay on the 17th June.

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Agra University.—The Executive Council of the Agra University, it is understood, have accepted the recommendations of the Committee appointed to consider the desirabiity of publishing a Journal, and have accordingly decided to issue annually a Journal, confined to the work done in the University. The Journal will comprise of two parts; Part I will comprise reports of original research work and the other part will contain summaries of extension lectures delivered under the auspices of the University.

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University of Calcutta.—The Sub-Committee appointed by the University of Calcutta to go into the question of instituting a Degree course in architecture has submitted its report recommending a 4-year course followed by a one year's training in the office of a practising architect recognised for the purpose by the University.

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University of Mysore.—The results of the Medical Examinations and the B.T. degree examination held in March 1937 were announced. They were as under:

	Examination	No. examined	No. passed
1.	First L.M.P. ..	49	36
2.	Second L.M.P. ..	52	31
3.	Third L.M.P. ..	40	25
4.	Final L.M.P. ..	58	24
5.	Final M.B.B.S. (Part I) ..	27	18
6.	Final M.B.B.S. (Part II)	25	17
7.	B.T.	69	39

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New Zeiss Apparatus.—After many years of experimenting Messrs. Carl Zeiss are now putting on the market their camera-microscope *Ultraphot* an instrument which has been eagerly looked forward to by many Zeiss friends.

The Ultraphot may truly be said to fulfil the wishes entertained by the supporters of "Camera Microscopes". Every branch of microscopy and photo-micrography has been duly considered in the construction of the instrument, combining monocular and binocular observation in bright and darkfield illumination by ordinary and polarised light for transparent and opaque objects with photomicrography at lowest, medium and highest magnifications. It is possible to attach Kinematographic apparatus of both standard and sub-standard size of films, and even such a specific kind of investigation as the observation and photography in luminescent light or as the photography in the ultra-violet and infra-red regions of the spectrum have been rendered practicable. For metallography, provision is made for using the Ultraphot as an inverted microscope with camera.

Particular attention has been paid to the illuminating device so often neglected in similar instruments. Exacting requirements, for which the Ultraphot has essentially been constructed, demand the fundamental principle of illumination—*i.e.*, that the image of the source of light should be projected into the aperture of the image-forming system—which is conveniently complied with by simple manipulations for all sizes of field and apertures.

* * *

Announcements.

Indian Science Congress.—For the occasion of the Silver Jubilee session of the Indian Science Congress, to be held in Calcutta from January 3rd–9th, 1938, certain Sections have been split up, and three new Sections thereby created. The complete list of Sections with their Presidents is as follows:—

(1) *Mathematics and Physics*: Dr. C. W. B. Normand, Director-General of Observatories, Meteorological Office, Poona, 5; (2) *Chemistry*: Prof. S. S. Bhatnagar, Director, University Chemical Laboratories, Lahore; (3) *Geology*: Mr. D. N. Wadia, Offg. Supdt. Geologist, Geological Survey of India, 27, Chowringhee, Calcutta; (4) *Geography and Geodesy*: Dr. A. M. Heron,

Director, Geological Survey of India, 27, Chowringhee, Calcutta; (5) *Botany*: Prof. B. Sahni, Professor of Botany, Lucknow University, Lucknow; (6) *Zoology*: Prof. G. Matthai, Professor of Zoology, Government College, Lahore; (7) *Entomology*: Mohamad Afzal Husain, Principal, Punjab Agricultural College, Lyallpur, Punjab; (8) *Anthropology*: Dr. B. S. Guha, Zoological Survey of India, Indian Museum, Calcutta; (9) *Agriculture*: Rao Bahadur T. S. Venkatraman, Imperial Sugarcane Specialist, Lawley Road, Coimbatore; (10) *Medical Research*: Sir U. N. Brahmachari, Kt., 82/3, Cornwallis Street, Calcutta; (11) *Veterinary Research*: Col. A. Olver, Animal Husbandry Expert, Imperial Council of Agricultural Research, New Delhi; (12) *Physiology*: Brev. Col. R. N. Chopra, Director, School of Tropical Medicine, Chittaranjan Avenue, Calcutta; (13) *Psychology*: Dr. G. S. Bose, University College of Science, 92, Upper Circular Road, Calcutta.

Under the new rules of the Association, the abstracts of papers will be printed in final bound form before the meeting. *The Executive Committee have, therefore, fixed August 15th as the last date for the submission of papers and abstracts.*

Since it is desirable that a very high standard should be maintained on the occasion of this session, the Executive Committee have decided that *no abstracts will be printed unless accompanied by the full paper at the time of submission*, thereby enabling the papers to be refereed by the Sectional Committees.

Regarding the Botany Section, Prof. B. Sahni, the President, has divided his section into six Sub-sections, with separate Chairmen. He asks us to request intending contributors to send their papers direct to the Chairmen of the appropriate sub-section, who will act as referees and advise the President. The following are the six Sub-sections :—

Cryptogams: M. O. P. Iyengar, Professor of Botany and Director, University Botanical Laboratory, Madras; *Phanerogams & Taxonomy*: S. P. Agharkar, Ghose Professor of Botany and Head of the Department of Botany, University of Calcutta; *Genetics & Cytology*: Dr. (Miss) E. K. Janaki Ammal, Geneticist, Imperial Sugarcane Station, Lawley Road, Coimbatore; *Mycology & Plant Pathology*: K. C. Mehta, Professor of Botany, Agra College, Agra; *Physiology & Ecology*: P. Parija, Professor of Botany, Revenshaw College, Cuttack; *Palæobotony*: B. Sahni, Professor of Botany, University of Lucknow.

As far as possible the meetings of the subsections will be held consecutively, in a continuous programme, so as to avoid their overlapping with each other.

* * *

The Inter-University Board.—The next annual session will be held at Allahabad in the month of November during the Golden Jubilee Celebrations of the Allahabad University.

We acknowledge with thanks the receipt of the following :—

" Agricultural Gazette of New South Wales, " Vol. 48, No. 4.

" Indian Journal of Agricultural Science, " Vol. 7, No. 1.

" Monthly Bulletin of Agricultural Science and Practice, " No. 4, April 1937.

" Journal of Agriculture and Livestock in India, " Vol. 7, No. 2.

" The Philippine Agriculturist, " Vol. 25, No. 9.

" Journal of the Royal Society of Arts, " Vol. 85, Nos. 4401–4404.

" Chemical Age, " Vol. 36, Nos. 926–929.

" Journal of Chemical Physics, " Vol. 5, No. 4.

" Journal of the Indian Chemical Society, " Vol. 14, No. 2.

" Russian Journal of General Chemistry, " Vol. 7, No. 2.

" Experiment Station Record," Vol. 76, No. 3.

" Transactions of the Faraday Society, " Vol. 33, Part 4.

" Indian Forester, " Vol. 63, Nos. 4 and 5.

" Indian Forest Records, " Vol. 2, No. 12.

" Forschungen und Fortschritte, " Vol. 13, Nos. 10–12.

" Transactions of the Mining and Geological Institute of India, " Vol. 31, Part 3.

" The Calcutta Medical Journal, " Vol. 32, Nos. 4 and 5.

" Review of Applied Mycology, " Vol. 16, No. 3.

" Journal of the Bombay Natural History Society, " Vol. 39, Nos. 4 and 5.

" Nature, " Vol. 139, Nos. 3518–20.

" Canadian Journal of Research, " Vol. 15, No. 3.

" Journal of Research, National Bureau of Standards, " Vol. 17, No. 6.

" Ceylon Journal of Science, " Section B, Vol. 20, Part 2 and Section D, Vol. 4, Part 3.

" Science and Culture, " Vol. 2, No. 10.

" The Sky, " Vol. 1, No. 6.

" Science Progress, " Vol. 31, No. 124.

" Indian Journal of Venereal Diseases," Vol. 3, No. 1.

Government of India Publications :—

" Indian Trade Journal, " Vol. 134, Nos. 1608–11.

" Bulletin of Industrial Research," No. 7.

CATALOGUES :

Messrs. Bausch and Lomb : " Research Microscopes and Accessories."

Messrs. Verlag von Gustov Fischer in Jena.

ACADEMIES AND SOCIETIES.

Indian Academy of Sciences :

April 1937.—SECTION A.—R. S. KRISHNAN : *Dispersion of Depolarisation of Light-Scattering in Colloids—Part II. Silver Sols.*—It is inferred that the particles of silver sols behave optically like elongated ellipsoids with the axial ratio equal to 0·75. It is suggested that the colloidal particles of silver may be in the form of minute octohedra which can be considered as optically equivalent to a prolate spheroid of the axial ratio 0·75. N. W. HIRWE AND B. V. PATIL : *Derivatives of Salicylic Acid—Part XI. Bromo-Salicylic Acids and their Methyl Ethers.*—A detailed study of these acids was undertaken as their chloralamides were required for other work. B. B. DEY AND T. K. SRINIVASAN : *The Preparation of Ortho-Phthalaldehydic Acid.* V. SEETHARAMAN : *Differential Invariants for Path Spaces of Order* 3. S. RAMACHANDRA RAO AND S. SRIRAMAN : *The Paramagnetic Susceptibility of Lithium.*—The mean value is found to be $2{\cdot}6 \times 10^{-5}$. T. R. SESHADRI AND C. VENKATA RAO : *A New Separation of the Components of* Psoralea corylifolia, *Linn.*—The components of the seeds have been isolated and examined. K. NEELAKANTAM AND T. R. SESHADRI : *Pigments of Cotton Flowers—Part IV. Constitution of Herbacitrin and Herbacetin—New Glucoside and Aglucone (Flavonol).* T. S. SUBBARAYA, B. NAGESHA RAO AND N. A. NARAYANA RAO : *On the Band Spectrum of Mercurous Iodide.*—The bands of group III have been measured under high dispersion and analysed. T. S. SUBBARAYA, N. A. NARAYANA RAO AND B. NAGESHA RAO : *On the Band Spectrum of Cadmium Iodide.*—Results obtained during an investigation of the group III bands of CdI are presented. N. W. HIRWE AND (MISS) K. D. GAVANKER : *Derivatives of Salicylic Acid.—Part XII. Nitro-Salicylic Acids and their Methyl Ethers.*—A new method for the synthesis of 3 : 5-dinitro-salicylic acid by nitration of salicylic acid is described. Dr. HANSRAJ GUPTA : *On a Conjecture of Chowla.*

April 1937.—SECTION B.—COL. I. FROILANO DE MELLO AND CÆTANO CORREA DE MEYRELLES : *On the Classification and Schizogonic Cycle of a Blood Parasite of the Indian Lizard* Calotes versicolor *Daud. Subspecies* Major *Blyth.*—The parasite has many interesting peculiarities which have enabled the authors to classify it as a new species. The existence of a *paranuclear body* so often figured in *K. lacertarum* and always present in the various evolutive stages of the parasite now studied, the presence of a polar capsule in gametocytes, the evident sexuality of gametocytes, the endoglobular and endothelial cycles of schizogony, the peculiar shape and structure of the micro-merozoites have not been described in any hæmogregarinid hitherto recorded. M. K. SUBRAMANIAM AND R. GOPALA AIYAR : *An Analysis of the Shape and Structure of the Golgi Bodies in the Eggs of Invertebrates with a Note on the Probable Modes of Origin of the Golgi Network.*

Indian Chemical Society :

February 1937.—TARAPADA BANERJEE : *On the Photochemical Oxidation of Organic Substances by Hydrogen Peroxide in Acid Medium with Inorganic Sols as Photosensitiser.* B. B. DEY AND (MISS) P. LAKSHMI KANTAM : *Studies in the Cotarnine Series—Part VIII. Derivatives of I-Aminomethylhydrocotarnine.* PRATUL NATH SEN-GUPTA AND B. C. GUHA : *Estimation of Total Vitamin C in Food-stuffs.* SHRIDHAR SARVOTTAM JOSHI AND T. MADHAVA MENON : *Studies in the Coagulation of Colloids—Part XVI.*—Further Investigation of the "Zonal effect" and the anomalous variations of the viscosity transparency and Refractivity during the coagulations of colloid antimony sulphide by Aqueous Mercury Chloride. RADHA RAMAN AGARWAL AND SIKHIBHUSHAN DUTT : *On Synthetic Coumarins—Part I.—Coumarins derived from Resacetophenone.* TEJENDRA NATH GHOSH : *Quinoline Derivatives—Part I.* M. GOSWAMI AND A. SAHA : *Composition of Boiled Oil.*—A preliminary Note. SAILESH CHANDRA SEN : *A Note on the Application of Potassium Ferricyanide Method for the Estimation of Reducing Sugars in Canejuice.* SACHINDRA NATH ROY : *A Note on the Use of Adsorption Indicator in Acidimetry and Alkalimetry.*

Society of Biological Chemists (India) :

Bangalore, 1st May 1937.—K. V. GIRI : *Magnesium activation of Tissue Phosphatases.* Y. V. S. IYER : *A Note on the Standardization of Food Materials.* V. SUBRAHMANYAN : *Volatilization of Ammonia from Soils.* M. V. GOVINDASWAMY : *Some Biochemical Factors in Mental Disorder.*

Forthcoming Events.

21–24 *June* 1937, *Simla.*—7th meeting of the Research Officers of the Central Board of Irrigation.

Besides discussing the reports of the Research Officers on the work done in their provinces during the preceding year the following new subjects will be taken up for discussion :—(1) Questionnaire on "Drains", and (2) "Note on the rise of water-table in canal irrigated areas of the Punjab," by Mr. E. S. Crump.

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